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COORDINATING FLUID MILK SUPPLIES IN THE PITTSBURGH MARKET

ECONOMIC RESEARCH SERVICE ● U.S. DEPARTMENT OF AGRICULTURE

PREFACE

This study is part of a continuing program of research on the influence that market organization and practices have upon efficiency in milk marketing.

This is the second report considering supply coordination in a specific milk market. The first was "Coordinating Fluid Milk Supplies in the Oklahoma Metropolitan Milk Market," Marketing Research Report No. 686, Nov. 1964, by Floyd A. Lasley. The Oklahoma study gives greater depth and detail in some comparisons, especially general problems in supply coordination, time flexibility, and milk-flow patterns. Both reports demonstrate the potential general application of the comparisons and alternatives.

Without the cooperation of the individual milk handlers, producers' cooperative associations, Allegheny County Health Department, and the Pennsylvania Milk Control Commission, these analyses would have been impossible.

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March 1966

SUMMARY AND IMPLICATIONS

The Pittsburgh milk market could function more efficiently and at less cost if there were more centralized coordination of the fluid milk supply and fewer reserve stocks. Individual milk handlers exercise a greater share of the responsibility for coordinating supply with demand in the Pittsburgh area than in most large markets. This report compares the efficiency of this type of market organization with a more centralized coordinating system for the market.

A larger reserve supply is required for each handler to coordinate his own supply with demand than if this function were performed by a central coordinating agency. Both random and competitive variations tend to be less disruptive marketwide than for the individual plants.

The volume of weekly milk receipts from producers at 7 plants fluctuated 21 percent less when the 7 volumes were combined than when the plants were considered individually. A central supply could have provided each of the 7 plants a uniform volume of milk with 60 percent of the weekly reserves they needed as individuals.

Daily receipts from producers at the 7 plants were within 10 percent of each plant's average 49 percent of the time. A coordinated supply would have been within 10 percent of its average 65 percent of the time. Individual plant receipts were within 15 percent of average 68 percent of the days, while the combined volume was in this range 86 percent of the time.

Reserve supplies are maintained to cope with fluctuations in demand and supply. Consumer demand for fluid milk generally does not vary as much as does the supply on a marketwide basis. This may not be true for individual handlers, especially those servicing contract outlets. In this case, there is no gradual buildup and decline, such as the seasonal change in production. Changes are abrupt and may be quite disrupting for producers and handlers, depending upon the type of supply management practiced.

For 16 weeks, the sum of the differences in fluid milk utilization between the highest week and the amount actually used each week by 7 individual plants was almost 3 times the difference for the same 7 plants combined (a 74-percent decrease by combining).

The total volume utilized as fluid milk by the 7 plants combined was extremely stable. Weekly utilization was within 5 percent of average nearly 94 percent of the time. Utilization in the individual plants was within this range slightly over half the time. Based upon average utilization, a 5-percent reserve would have met all of the week-to-week fluctuation in fluid use for the 7 plants combined. A 5-percent reserve would have left the individual plants short because of variation in fluid use 20 percent of the time. A 20-percent reserve would have met the fluid needs of the individual plants 99 percent of the time.

The combined fluid use for the 7 plants was between 90 and 104 percent of average every month; yet, separately, the plants were outside this range almost half the time. Again, a 20-percent reserve would have covered month-to-month variations in fluid use of the individual plants 99 percent of the time.

When the 7 weekly plant volumes were combined, they had 25 percent as much surplus owing to variation in fluid use, and 79 percent as much surplus owing to variation in milk receipts from producers as when the plants were considered separately. During 16 weeks, the surplus resulting from interacting variations in receipts from producers milk and fluid use was almost twice as much for the individual plants as for the combined volumes (32.9 and 16.7 million pounds). Proportionately less reserve would have been needed to serve the combined volumes.

The most satisfactory ratio of milk receipts from producers to fluid utilization in each market depends upon the desired goals and the interrelationships of several variables. However, there are effective alternatives so that each handler, or even each market, need not meet all needs solely with current producer receipts. The reserve provided by any level of supply management is not carried just during the short period--it contributes to the surplus problem all year.

The very nature of the milk industry requires flexibility in all operations from producer to consumer. Yet there are costs in providing this flexibility. This report summarizes ways of measuring fluctuations and reducing the costs of coping with them.

Certain functions can be performed more efficiently by some marketing agencies than by others. These comparative advantages vary with time and changing situations. Market organization is a dynamic force--not a passive or rigid arrangement. The different relationships evolve over time as participants, individually and collectively, seek to establish a more favorable competitive environment. The institutional framework, especially county and State, probably helps to maintain the coordinating responsibility at the individual handler level in the Pittsburgh market.

The relationship between organization and degree of service provided under different supply coordinating arrangements is relevant to price determination, whether effected strictly by bargaining in the market place or in part by regulatory administrative action. Coordination, reduction of uncertainty, and provision of flexibility and operating stability are necessary functions of the marketing system. Price needs to reflect their value and cost by rewarding those responsible for executing these functions. There also are pricing problems in the functional balance between producer milk receipts and fluid utilization.

COORDINATING FLUID MILK SUPPLIES IN THE PITTSBURGH MARKET

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INTRODUCTION

How does market organization affect functional efficiency in a fluid milk market? This study seeks to determine and evaluate differences in the relative efficiency of alternative methods of coordinating the total milk supply with demand. Marketing firms employ various means to achieve a degree of balance between supply and demand. Some of these have resulted in greater efficiency--some in less. The degree of efficiency is compared by two measures: (1) The relative portion of the milk supply which must be carried as necessary reserves, and (2) the relative cost of managing and handling the flow of milk by different methods. Uncertainty is one of the major problems that confronts plant managers, and requires a high proportion of time, effort, and expense. Reducing the degree of fluctuations and uncertainty reduces costs and improves efficiency, both directly and indirectly. Milk marketing costs are forced upward as supplies and sales become more variable, because labor is less productive, facilities cannot be utilized fully, markets cannot be served as effectively, and a higher ratio of reserve milk must be maintained. The sucessful milk handler must provide an adequate degree of flexibility without maintaining excessive reserve capacity and the associated costs.

Supply coordination is accomplished by methods ranging from a highly centralized system to an individual handler system. The general pattern has been a shift toward a more central responsibility for coordinating the supply of milk. Although there has been some shift in this direction in the market, supply coordination in Pittsburgh generally is exercised by the individual dealers.

The appropriate action to achieve a desired change in the supply-demand ratio depends upon the firm involved and the cause of the imbalance. Stimuli to alter the pattern of producer receipts would be quite different from those designed to alter sales. The different firms, sometimes with conflicting goals, would be seeking different balances and different flow patterns. Their ability to influence either the supply or the demand side of the ratio would be quite different.

Producer receipts, demand for fluid milk and other dairy products, and the ratio of supply to demand all vary. Under each of these, dealers experience random and nonrandom variations of different time periods. These three types of fluctuation are considered separately to emphasize relative changes, causes, and implications.

Dealers can use the comparisons to measure their individual problems and to identify and evaluate alternatives. The manager coordinating supply with demand for a group of plants, or for the entire market, can analyze alternatives for individual plants and for the combined group.

Each section considers supply management problems of that particular phase. The potential impact of central supply coordination and a discussion of its advantages and disadvantages are summarized in the final section, Conclusions.

METHODOLOGY

The case study approach was used to compare relationships under the various coordinating systems. This report is based upon a study of the Pittsburgh, Pa., marketing area. Description of the coordinating process in specific markets serves to emphasize opportunities within those markets and to illustrate potential alternatives for other markets. Generalizations are made of several comparisons in the report under the appropriate section because of the differences in application to various market conditions.

Primary data for 1963 were obtained from records and personal interviews with personnel representing individual handlers, producers' cooperatives, manufacturers, and the Allegheny County Health Department. Additional background information was secured from the Pennsylvania Milk Control Commission, the Greater Pittsburgh Dairy Industry Association, and dairy and marketing specialists at Pennsylvania State University.

Costs, efficiency, reserves, and other measures are considered in a relative sense rather than as absolute measures. This permits application to more diverse market conditions. This report does not emphasize statistical tests of significance; rather, differences are used to illustrate and compare alternatives as plants and groups of plants are compared in several ways to show the problems involved in coordinating the supply of milk and to suggest and quantify effects of alternative solutions.

Except as noted, the competitive situation as influenced by producers, outlets, product mix, prices, governmental programs, regulations, quantity, and quality was assumed to remain at the existing level. This report recognizes but does not analyze the costs of procurement, farm quality control, collection, and assembly, each of which offers potential savings through supply coordination.

Responsibility for coordinating the flow of milk may be exercised by the individual plant, by a group of plants, a broker, by a producers' cooperative or federation of cooperatives, or by a combination of these. The coordination might be for a single plant or for the entire market. The level at which this responsibility is exercised is considered to be the relevant variable.

Aggregate comparisons do not provide adequate guidelines for individual operating decisions. This report generally considers variations in relation to an average flow pattern for some specified time period (day, week, month, year). This is not intended to imply that the average or any other given relationship is the most desirable level. These benchmarks were chosen as convenient points for quantifying and comparing fluctuations.

This report compares the degree and frequency of fluctuation and uncertainty which individual plants and various groupings of these plants in the Pittsburgh marketing area would have encountered under different systems of supply coordination. These groupings are not actually found in the market, but demonstrate potential gains and efficiencies.

The comparisons of supply and demand are based upon producer receipts and fluid utilization associated with each plant. Milk supplies needed for other products contribute to the balancing problem. Within the scope of this study, it was impractical to ascertain the extent to which nonfluid utilization was demand-created and to what extent it was an effort to balance supply with fluid or total utilization. Operating flexibility was increased by manufacturing and promoting nonfluid products to gain timeliness in the market and volume control, but these oportunities were not exploited fully.

The same techniques are applicable in comparing fluctuations and uncertainties associated with alternative organizations for fluid, nonfluid, or total utilization. The measures would be very similar, although the appropriate actions to alleviate the coordinating problems would differ.

Dealers find it difficult to measure and express degrees of variation. They can use these comparisons to measure the fluctuation, the probability of a given fluctuation, the cause, the interrelationships, the expected impact upon operations, and to evaluate alternatives.

Definition of Terms

The following terms are used with slightly different meaning or limitation in certain markets. To prevent confusion, they are used to express the following concepts in this report.

Producer receipts--milk collected from farms of producers regularly supplying the specific plant or plants. This includes all such producer milk irrespective of destination or use.

Fluid milk--processed for consumption as whole milk, skim or modified skim, chocolate milk, cream, and milk-cream mixtures. In the Pittsburgh market these products are classified as Class I and IA.

Surplus--that portion of producer receipts above fluid utilization. It may be used by the handler in his regular nonfluid products, diverted, or sold to a manufacturing plant. Surplus milk includes excess milk.

Excess milk--that portion of producer receipts not used by the handler in his regular fluid, cottage cheese or ice cream operations. The handler may use it to manufacture lower priority products (butter, powder, condensed) or divert or sell it to a manufacturing plant. This milk is excess to the regular operation. It does not include sales to other handlers for fluid use.

Diverted milk--milk moved from the farm to a manufacturing plant without being received by the handler usually receiving milk from these farms.

Handler and dealer--used interchangeably in this report to identify plants processing fluid milk. Regular handler--a fluid processing plant that receives milk directly from farmers (producer receipts). Such a plant also may receive additional milk from other sources.

Full-supply--an arrangement whereby one firm (usually a producers' cooperative) supplies another with milk according to his needs. The supplier is responsible for meeting and handling all shortages and surpluses. Beyond these basic conditions, several alternatives exist regarding degree of service and responsibility. The supplying plant may or may not process surplus milk into manufactured products.

Coordination of supply with demand--includes procurement, collection, assembly, diversion, transfer, securing supplementary supplies, and surplus handling. In central supply coordination, one firm exercises these responsibilities for a group of plants. In individual supply coordination, these functions are performed primarily by the individual plant.

Combined volume--the summation of the individual plant volumes. This in no way implies mutual interests or actual plant consolidation by the handlers.

DESCRIPTION OF THE MARKET

This report considers the flow of milk in the Pittsburgh, Pa. marketing area during 1963. No effort was made to distinguish the milk that was sold in or obtained from different areas by any of the handlers. A plant competing in the immediate Pittsburgh market was included, whether that plant was securing milk directly from producers or from another plant. The plant may have been selling all the milk receipts as fluid milk, or processing a portion of them into other products, or even acting as a supply plant for another plant.

The Pittsburgh market is a major portion of that designated as area number 2 by the Pennsylvania Milk Control Commission. Area number 2 includes all municipalities in the following counties: Allegheny, Armstrong, Beaver, Butler, Fayette, Greene, Lawrence, Mercer, Venango, and Washington. Most of the municipalities in Clarion, Crawford, and Westmoreland counties are also included.

Eight producer cooperatives regularly provided milk for handlers in the area. Two cooperatives were operating processing and distributing systems. Three Wisconsin producers' cooperatives provided supplementary supplies in the form of intermediate products (cream, condensed milk, and powder). These supplementary shipments were very erratic. Each handler was responsible for obtaining supplies for his own operation.

The Milk Control Commission regulates minimum prices charged for milk at all levels, including producer milk, wholesale, and retail. This applies to all types and sizes of containers. Cottage cheese and ice cream prices are not regulated. Although minimum farm prices are set, neighboring producers may receive different blend prices as class utilization varies between handlers. Proceeds for producer milk are allocated by an individual-handler-type pool, although there is considerable reblending by producers' cooperatives. Special problems are involved in coordinating the supply for an individual handler pool. There are incentives for certain individuals to operate outside a central coordinating arrangement.

The Milk Control Commission listed a total of 66 dealers in marketing area number 2 in 1963. Some of the dealers outside the immediate Pittsburgh market are not included in this study. Total receipts and utilization for all dealers in area number 2 are summarized in table 1, with a description of the classes of dairy products.

Data were obtained for 54 plants, but all were not comparable and some were inadequate. Some plants participated only incidentally in the Pittsburgh market. Detailed daily flow records were analyzed for 29 plants (11 regular handlers and 18 supply plants) and for 10 full-supply plants. The 29 plants received producer milk equal to 156 percent of the total fluid milk sales in area number 2.

A total of 18 supply plants were included in the analysis. Some were primarily responsible to one processing plant, while others were actively seeking several market outlets.

All fluid milk sold by plants in the area must be produced on farms approved by the Allegheny County Health Department. This includes all supplementary supplies as well as regular supplies. It also includes all milk for ice cream, cottage cheese, condensed milk, and any intermediate milk products which are used to make other products that are sold by these dairy plants.

Table 1.--Milk receipts and utilization by all dealers in Pennsylvania marketing area number 2, 1963 1/

Item	Received from Pennsylvania producers	Received from out-of-State producers and other plants	Total from all sources
	1,000 pounds		
Milk received	880,649	374,681	1,255,330
	Percent		
Class I in area 2/	48.30	67.31	53.97
Class I other areas	3.16	1.95	2.80
Class I outside State	.72	3.90	1.67
Class I A 3/	3.51	3.05	3.37
Class II 4/	29.78	13.43	24.90
Class III 5/	11.82	10.27	11.36
Manufacturing, outside State	2.64	.09	1.88
Adjustment	.07	---	.05
Total	100	100	100

1/ Data provided by Pennsylvania Milk Control Commission (primarily in Bulletin 746).
2/ Class I is fluid products except cream.
3/ Class I A is fluid cream.
4/ Class II is cottage cheese, ice cream, and condensed milk.
5/ Class III is butter and cheese.

Milk shipped from out-of-State sources does not come under the minimum price to producers established by the Milk Control Commission, but, if sold in the area, it is subject to wholesale and retail price regulation. There is considerable price incentive for a handler to bring in out-of-State milk.

This report is not an analysis of State milk control, the Pennsylvania Milk Control Commission, or other regulatory agencies. However, the institutional framework does influence competitive relationships and the alternatives available to the industry. In this report, these institutional factors have been accepted as predetermined and outside the parameters of this analysis. The fluctuations and uncertainties, and the potential efficiency gains from their reduction through organizational adaptations, are presented within the existing framework. Changes in these institutional factors would not invalidate the relationships shown between different levels of organization, but probably would exert pressures for subsequent organizational adaptations.

The market displayed a variety of means for coordinating the milk supply. Some handlers were responsible for their own milk procurement and assembly of supply; others depend upon a producers' cooperative or supply plants to furnish milk as needed. Some handlers operated between these two extremes. One handler has been operating with a full-supply arrangement since the early 1930's. Surplus was handled predominantly by the individual plants on an opportunity basis, with very little coordination.

Population and milk production figures for Pennsylvania are compared with U.S. totals in table 2. The 13 counties embracing area number 2 represent approximately 28.5 percent of the total State population and 15.4 percent of the milk production. Population and milk production in the area have been increasing less rapidly than in the State as a whole. Pennsylvania's population has been increasing at a slower rate than the U.S. total. The State has been increasing its share of milk cow numbers and milk production.

GENERAL PROBLEMS IN SUPPLY MANAGEMENT

A firm integrating the functions of procurement, assembly, processing and distribution has numerous alternatives for adjusting operations to fluctuating demands and supplies. The actions taken will depend largely upon the frequency and severity of the fluctuations, the division of fluid sales between retail and wholesale, whether or not the firm operates manufacturing facilities, the ease of disposing of surplus, the volume of milk handled in each phase of the business, the procurement area, the availability of supplementary supplies, and institutional arrangements influencing the market.

The actual processing pattern is seldom ideal when viewed separately from the viewpoints of supply, demand, processing, or distributing. Each component may prefer a daily, weekly, and seasonal pattern that is quite different either from the actual one, or that preferred by the overall organization. The objectives of the component parts are subordinate to those of the total firm.

Exceptional or unusual supply-demand situations require managerial decision and action. The ordinary problems are handled by routine procedures designed to minimize managerial effort. Under conditions of uncertainty, a market system must provide the flexibility necessary to effectively balance supply with demand. The greater the uncertainty, the greater the flexibility necessary. Operating flexibility is costly to provide. Firms with more uniform operations may have a significant competitive advantage.

Table 2.--Pennsylvania population, milk cow numbers, and milk production compared with U.S. totals for 1940, 1950, and 1960

Year	Pennsylvania			Pennsylvania as a percentage of U.S.		
	Population	Milk cows	Milk produced	Population	Milk cows	Milk production
	1,000 people	1,000 cows	1,000,000 pounds	Percent	Percent	Percent
1960. . . .	11,319	884	6,807	6.3	5.0	5.5
1950. . . .	10,498	891	5,631	6.9	4.1	4.8
1940. . . .	9,900	860	4,696	7.5	3.6	4.3

Why Carry Reserve Supply?

An individual dealer or a producers' cooperative carries a reserve to assure a supply adequate to meet the needs at certain critical times. This reserve is necessary because of fluctuations, actual or potential, in supply, utilization, or both.

The contraseasonal pattern of supply and demand exaggerates the effects of both fluctuations. Variations among individual dealers within a group as well as between supply and utilization often offset each other.

A major source of the potentially improved efficiency resulting from the centralized management of milk supplies is outside the individual firm. Central management of milk supplies provides a vehicle for orderly market development and introduction of new technology. Alternatives available at a given stage of development depend directly upon decisions made during previous stages, with a high degree of interdependence among market participants. Decisions by individual firms may limit the alternatives available to themselves and to others.

Time Flexibility

The problem of balancing short-term supply and demand is increasing. 1/ Several opportunities for manipulating the milk flow so as to provide a more desirable balance are found in the assembly-processing-distribution complex. Timeliness may be improved by speeding or delaying the flow of milk through the system. The several phases may be coordinated or each may function as a managerial entity, although directly dependent upon complementary functions.

The farm bulk tank offers the first possibility for varying the rate at which milk moves. Other possibilities for adjustment include the collection truck, reload station, over-the-road tanker, manufacturing plant, bulk storage at the plant, packaged milk storage, refrigerated truck, distributing point, and retail store. The product mix may be varied and intermediate products used to improve timing.

Retail route deliveries normally are made two or three times per week. Consumers have been shifting from home delivery of milk to purchasing it in retail stores. Many purchase an entire week's supply at one time. The heavy shopping days are Friday and Saturday; midweek purchases are light.

The flow through the marketing system normally requires 4 to 6 days for fluid milk products. This easily may be varied 2 full days in either direction. When timeliness is urgent, this flow may be hastened to a matter of hours or stretched out to 10 or 12 days.

FLUCTUATING PRODUCER RECEIPTS

Producer receipts are subject to three types of variation: (1) long-term or cyclical, (2) seasonal, and (3) short-term.

Procurement personnel are concerned with two major volume considerations: (1) the total volume, and (2) the pattern of receipts. An individual dealer desires to receive milk as needed for his operation, while a central coordinator seeks to

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1/ Time flexibility is considered more fully in "Coordinating Fluid Milk Supplies in the Oklahoma Metropolitan Milk Market," U.S. Dept. Agr. Mktg. Res. Rpt. No. 686, Nov. 1964.

provide each one of a group of plants with an adequate supply. The scope of each problem is quite different.

Seasonal Producer Receipts

Seasonal variation in milk production on farms has decreased in most fluid milk markets. Pricing policies designed to reward producers for more uniform production have achieved some success. Larger, more specialized dairy farms with high fixed costs have contributed to a less variable seasonal production pattern.

The timing and general extent of seasonal changes in milk production may be predicted rather accurately. Changes in weather and feed conditions cause some variation from the usual seasonal pattern, but the degree of uncertainty is not serious. Handlers are in a position to ready their facilities for the anticipated change.

Table 3 shows seasonal variation at 29 plants serving the Pittsburgh market area, individually and as groups of plants combined. The 7 combined are the plants which are considered further in balancing supply and demand on a daily, weekly, and monthly basis. These 7, with 4 additional plants, make up the group of 11 regular fluid dealers who depend primarily upon producer receipts. The 18 supply plants are grouped into a combination, and then are combined with the 11 to secure the total for 29 plants. Some of these supply plants are located outside Pennsylvania. The 7 plants received an average of 962,100 pounds of milk per day from producers in 1963. The 11 received 1,198,300 pounds per day, while the 18 supply plants received 2,110,800 pounds. Total daily producer receipts by the 29 plants averaged 3,309,100 pounds.

There were instances in which the plants shown were involved in considerable competitive producer patron shifting from one plant to another, but these were considered to be a part of the variability and uncertainty which confront management of plants receiving milk directly from producers. One such instance does influence the comparison between weekly and seasonal fluctuations.

Monthly producer receipts were very level for 6 months, at a slightly higher level for 2 or 3 months, and at a high level for a 3-month period (fig. 1). The summer decline was rather sharp. While there were individual differences, seasonal patterns for the two groups of plants were similar.

Daily Receipts by Handlers

Daily producer receipts by a plant vary because of fluctuating production and differences in collection of the milk by bulk truck. The variation of volume collected is especially marked for smaller plants, because of the difficulty of balancing every-other-day collections, while haulers try to maintain a full load of milk each trip.

March, May, September, and December 1963 illustrate the daily flow of milk. These months, with the various holidays and abrupt changes in consumption and receipts, show practices used by marketing firms to minimize the problems resulting from such fluctuations. Producer receipts during these 4 months was 34.8 percent of the yearly total; fluid use was 34.3 percent, and Class II (cottage cheese, ice cream, condensed milk) use was 34.5 percent of the 1963 total.

Random fluctuations result from weather conditions, road conditions, equipment difficulties, changes in producers, illness, and other changes affecting

Table 3.--Seasonality of producer receipts, 29 plants serving the Pittsburgh area, 1963

Type of plant	Daily average by month as percentage of 1963 daily average											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	Percent											
Bottling Plants:												
A	95	100	109	120	132	123	89	87	88	87	83	88
B	103	104	108	112	120	114	97	92	89	85	86	91
C	95	99	106	112	128	121	101	94	90	84	84	87
D	106	108	112	111	115	105	91	87	90	91	92	94
E	94	100	108	115	128	118	88	94	92	86	86	89
F	102	105	109	111	117	106	92	93	91	86	90	98
G	101	103	104	108	111	96	85	88	95	100	103	107
7 plants combined 1/	100	103	108	113	122	114	93	91	90	88	88	92
H	84	97	102	116	122	106	95	92	99	99	97	89
I	105	107	108	113	115	103	85	84	87	90	95	107
J	101	103	107	111	116	107	91	89	89	88	96	103
K	104	104	112	118	117	113	96	93	91	84	83	84
11 plants combined 1/	100	103	109	113	121	112	93	90	90	88	89	93
Supply plants:												
L	91	92	92	99	116	108	96	101	103	100	102	102
M	89	92	96	105	118	121	109	102	98	94	86	89
N	91	96	106	102	103	107	89	88	103	107	105	105
O	100	103	107	110	113	104	95	93	91	90	95	99
P	109	100	103	111	127	121	88	69	86	88	98	100
Q	99	97	104	113	122	121	100	92	90	83	92	89
R	85	90	99	112	121	120	99	91	90	85	87	78
S	107	94	95	101	111	112	96	97	94	98	96	100
T	103	105	111	116	125	113	96	91	90	85	87	78
U	92	95	101	108	117	116	102	100	98	92	89	91
V	93	97	108	114	124	126	107	94	79	88	84	87
W	101	102	108	117	123	117	96	89	88	87	88	85
X	93	94	102	112	120	122	106	96	93	89	86	88
Y	110	113	117	122	127	116	93	83	79	76	81	86
Z	107	107	115	122	129	116	97	97	81	78	80	84
AA	104	105	115	118	129	127	88	88	88	75	73	91
BB	97	99	103	108	119	117	89	92	96	94	92	96
CC	98	100	101	105	117	115	104	93	87	88	92	98
18 plants combined 1/	98	98	103	110	120	117	97	91	91	90	91	94
29 plants combined	99	100	105	111	120	116	96	91	91	89	90	93

1/ The 7 plants are regular handlers who depend primarily upon producer receipts. These 7 are considered in more detail in the analysis. These 7 plus 4 regular handlers are the 11 plants. A part of the 18 supply plants are located outside area Number 2, but are actively servicing the Pittsburgh market.

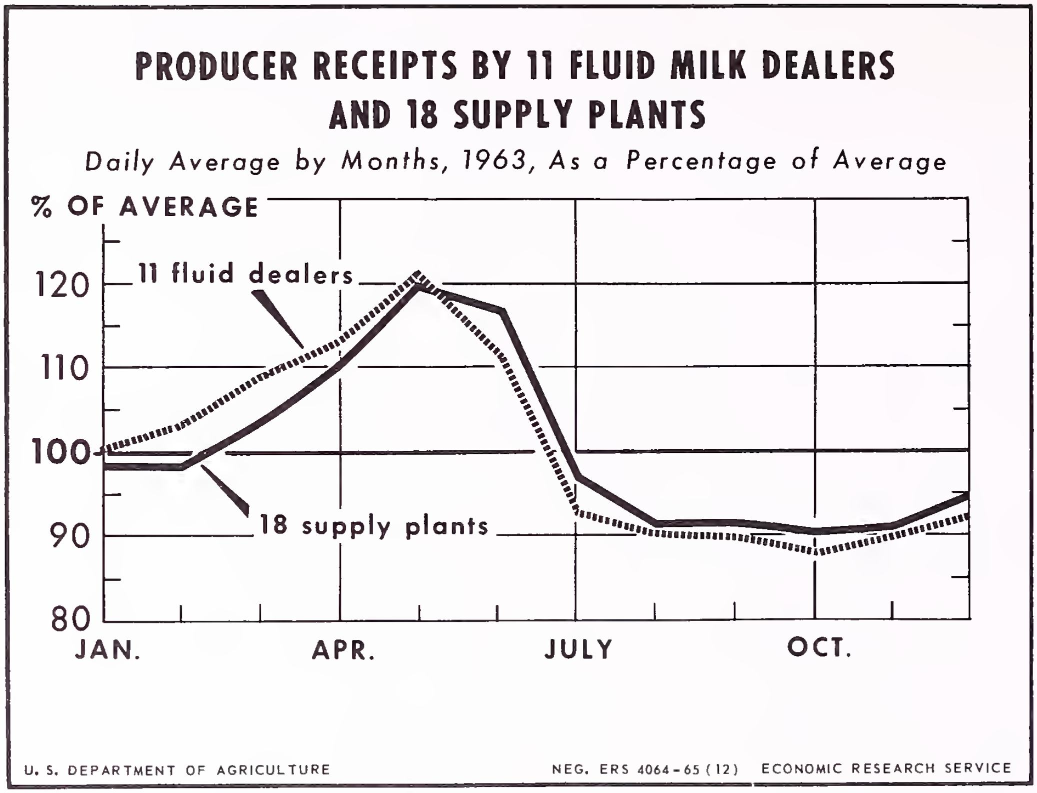


Figure 1

milk production and collection. A rather minor variation in any one of these factors can cause receipts to fluctuate markedly from day to day. A relatively small increase in total production may make adjustment necessary in the producers served on a given truck run, effecting a new alignment of producers and volume.

Table 4 summarizes the pattern of daily producer receipts for the combined volumes of the 11 regular fluid dealers, the 18 supply plants, and the total of the 29 plants. Seasonal differences cause the 4-month summary to have lower modal peaks and to be drawn out more at both ends than are the monthly distributions.

Weekly Producer Receipts

Handlers consider the week as an operating period. They do not strive for a daily balance between receipts and utilization, but generally seek such a balance on a weekly basis, so the week is the most appropriate period to compare fluctuations.

The daily records from March, May, September and December 1963 were used to obtain the weekly patterns and variations from averages. Four consecutive weeks were used in each month, starting with the first Sunday in each month (June 1 was used to complete the last week in May).

Table 5 compares weekly fluctuations in producer receipts for 7 dealers who depend primarily upon producer receipts for their supply. Actual producer receipts during each week are shown as a percentage of the 16-week average volume for each individual plant and for the volume of the 7 combined.

Table 4.--Percentage of time that daily producer receipts by 29 Pittsburgh area plants (11 regular and 18 full-supply plants) were a specified percentage of average March, May, September, and December 1963

Range, percentage of average	Percentage of time in range (123 days)														
	11 regular plants combined					18 supply plants combined					29 plants combined				
	March	May	Sept.	Dec.	4 months	March	May	Sept.	Dec.	4 months	March	May	Sept.	Dec.	4 months
	Percent														
0-60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
65	--	--	--	3.2	.8	--	--	--	--	--	--	--	--	--	--
70	--	--	--	--	--	--	--	--	3.2	.8	--	--	--	3.2	.8
75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
80	--	--	10.0	3.2	3.3	--	--	--	6.5	1.6	--	--	--	--	--
85	--	--	13.3	9.7	5.7	--	--	23.3	54.8	19.5	--	--	3.3	38.7	10.6
90	6.5	--	33.3	48.4	22.0	3.2	--	60.0	25.8	22.0	--	--	73.3	54.8	31.7
95	35.5	3.2	23.2	29.0	22.8	35.5	--	16.7	9.7	15.4	41.9	--	23.3	--	16.3
100.	41.9	3.2	20.0	3.2	17.1	48.4	--	--	--	12.2	51.6	--	--	3.2	13.8
105.	16.1	19.4	--	3.2	9.8	12.9	3.2	--	--	4.1	6.5	9.7	--	--	4.1
110.	--	45.2	--	--	11.4	--	25.8	--	--	6.5	--	29.0	--	--	7.3
115.	--	25.8	--	--	6.5	--	29.0	--	--	7.3	--	48.4	--	--	12.2
120.	--	3.2	--	--	.8	--	32.3	--	--	8.1	--	12.9	--	--	3.3
125.	--	--	--	--	--	--	9.7	--	--	2.4	--	--	--	--	--
130 +.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 5.--Milk receipts for each of 16 weeks as a percentage of average weekly receipts during the period, 7 bottling plants in the Pittsburgh area, selected months, 1963

Period	Plant A	Plant B	Plant C	Plant D	Plant E	Plant F	Plant G	Combined total 7 plants	Mean points variation 1/
	Percent								
March:									
1st week .	101	95	94	103	100	103	96	99	3
2nd week .	106	99	93	102	103	104	100	100	3
3rd week .	104	99	96	102	104	106	104	101	4
4th week .	107	115	96	103	107	107	103	104	7
Range. . .	6	20	3	1	7	4	8	5	---
May:									
1st week .	124	107	109	100	118	110	103	110	10
2nd week .	129	110	117	99	126	115	99	113	14
3rd week .	127	111	116	99	125	117	111	113	15
4th week .	126	110	118	96	123	114	114	113	16
Range. . .	5	4	9	4	8	7	15	3	---
September:									
1st week .	82	104	106	99	91	88	91	96	8
2nd week .	87	94	113	98	88	88	91	97	10
3rd week .	91	91	115	100	88	88	90	98	10
4th week .	84	92	118	102	86	86	90	98	12
Range. . .	9	13	12	4	5	2	1	2	---
December:									
1st week .	83	92	76	101	83	92	103	89	11
2nd week .	82	92	76	104	87	93	96	90	11
3rd week .	83	95	78	99	83	94	108	90	11
4th week .	83	93	79	92	88	96	102	88	10
Range. . .	1	3	3	12	5	4	12	2	---
	Percentage points								
Total range	47	24	42	12	43	31	24	25	---
Mean points variation 1/	16	7	14	2	13	9	6	7	10

1/ Mean variation from average (100) expressed in percentage points.

Supply varied much less for the combined volume than for the individual plants. The mean weekly supply variation was 7 percentage points for the 7 combined and 10 points for the individual plants. Some plants were more successful than others in their efforts to reduce supply fluctuations. Plant D had developed a pattern that was exceptionally uniform seasonally as well as within each month.

For the 16 weeks, producer receipts for the 7 plants as individuals were a total of 15,698,000 pounds greater than they would have been had receipts been constant at the level of the low week for each plant (table 6). The comparable figure for the 7 as a unit was 12,387,000 pounds, 21.1 percent less. The total individual variation was 13.9 percent of total producer receipts while the combined volume variation was 11.0 percent.

The last column in table 6 shows the combined volume above minimum weekly receipts less 206,000 pounds. Due to offsetting variations among plants, a combined supply could have provided each of the 7 plants with a volume equal to its minimum producer receipts using 206,000 pounds less per week than the combined volumes would indicate. This was based upon the difference in reserve for the first week in December, the low point for the 7 combined. This figure indicates that this smaller volume of producer receipts could have provided the coordinated supply as adequately as the larger volumes satisfied the several individual plants. The 16-week sum of 9,091,000 pounds reserve supply in the last column compares with the 15,698,000 pounds for the 7 individual plants. The smaller reserve figure is 60 percent of the larger.

This efficiency is gained due to compensating differences in the individual variations. The significance of the comparisons in table 6 is that, with the pattern of producer receipts experienced by these 7 plants, a common supply could have provided each plant, for 16 weeks, with an amount equal to the plant's receipts in the low week using a total of 6,607,000 fewer pounds of milk than the 7 would have needed under individual supply management.

To state the comparison in another way, the individual reserve supplies necessary to provide the minimum weekly volume for each plant would have added 15.7 million pounds of surplus milk, while the combined supply could have provided each plant with the minimum level adding only 9.1 million pounds to surplus uses. These volumes represent the 16-week reserve for fluctuations in producer receipts only. Other fluctuations are considered elsewhere.

Figure 2 and table 7 compare the relative daily, weekly, and monthly fluctuations in producer receipts for 7 bottling plants considered individually and collectively.

Producer receipts by the 7 individual dealers were within 10 percent of their average for the time period 49 percent of the days, 61 percent of the weeks, and 54 percent of the months. Increasing the range to 15-percent variation from average raised these percentages to 68, 75 and 84. A coordinated supply for the 7 would have had a variation of 10 percent or less 65 percent of the days, 56 percent of the weeks, and 58 percent of the months. The percentage of time that combined receipts were within 15 percent of average was 86,100, and 92, respectively. Comparing this pattern with table 7 shows the smoothing effect realized from coordinating the several supplies as one general supply.

These same comparisons emphasise the differences in variability of the daily, weekly, and monthly receipts from producers. While the normal accounting period is a month, handlers operate on a weekly basis. The accounting period tends to conceal the degree of variability actually experienced in the operating period. The daily

Table 6.--Milk receipts for each of 16 weeks and the volume above minimum for 7 bottling plants in the Pittsburgh area, selected months, 1963

Period	Actual producer receipts	Producer receipts volume above minimum level 1/		
		Sum of 7 individual plants 2/	7 plants combined 3/	7 plants combined, less 206,000 4/
	1,000 pounds			
March:				
1st week. .	6,976	894	689	483
2nd week. .	7,086	1,004	799	593
3rd week. .	7,150	1,068	863	657
4th week. .	7,368	1,287	1,081	875
May:				
1st week. .	7,734	1,653	1,447	1,241
2nd week. .	7,990	1,907	1,703	1,497
3rd week. .	8,008	1,926	1,721	1,515
4th week. .	7,966	1,884	1,679	1,473
September:				
1st week. .	6,794	711	506	300
2nd week. .	6,853	772	567	361
3rd week. .	6,911	830	624	418
4th week. .	6,908	826	621	415
December:				
1st week. .	6,287	206	0	-206
2nd week. .	6,325	244	38	-168
3rd week. .	6,336	252	49	-157
4th week. .	6,247	234	5/ 0	-206
Total . . .	112,939	15,698	12,387	9,091

1/ Volume of producer receipts in excess of the minimum weekly producer receipts (excluding December holidays as low).

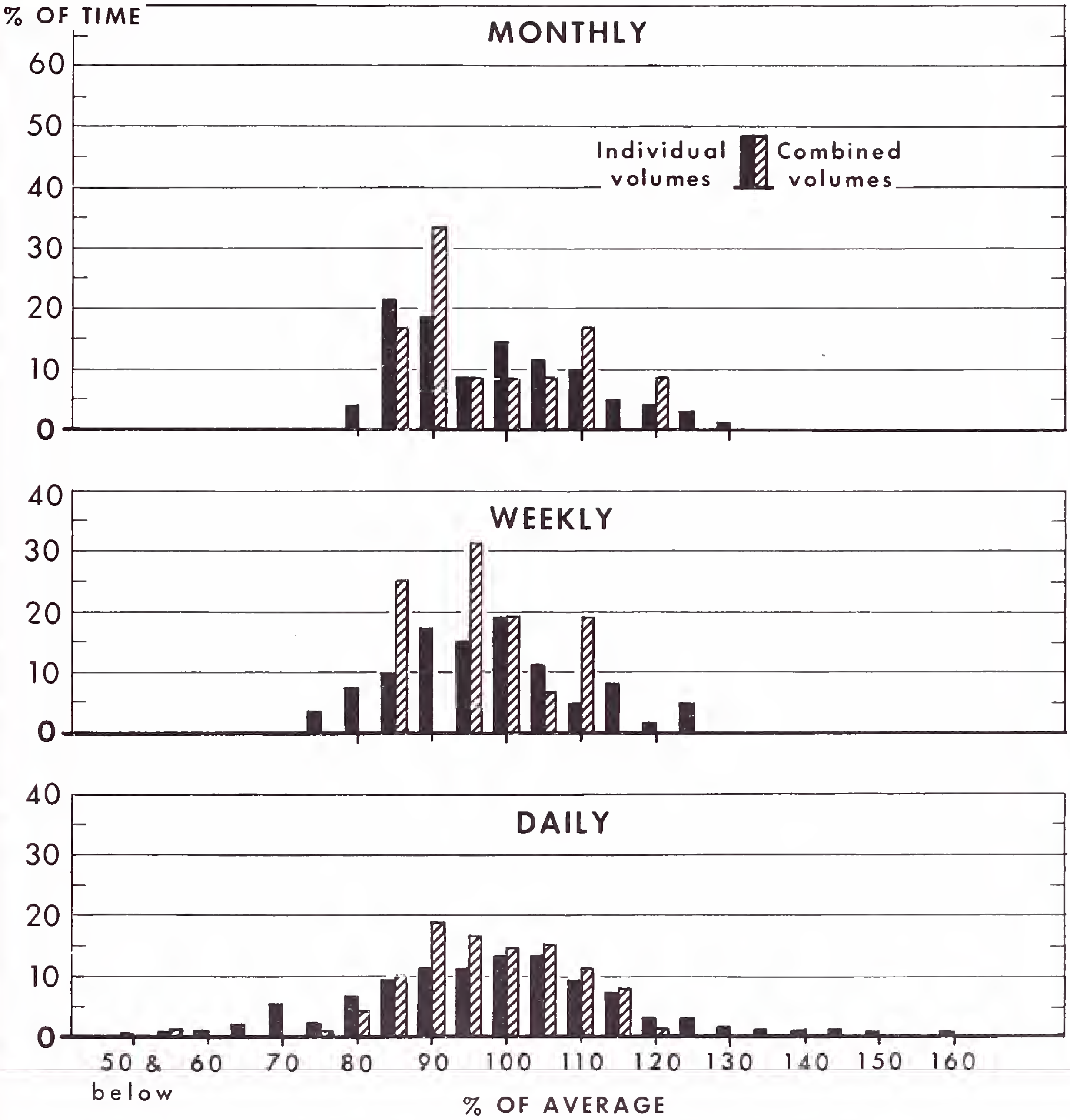
2/ Sum of producer receipts by each plant above its own minimum weekly producer receipts.

3/ Weekly producer receipts in excess of the lowest weekly producer receipts (first week in December) for the 7 plant volumes combined.

4/ Producer receipts for 7 plants combined minus 206,000, the difference for the first week in December between summing the 7 individuals and combining the 7 as a unit. With this volume, the combined supply could have provided each plant with a constant level of receipts equal to its minimum weekly producer receipt volume.

5/ Adjusted for holiday influence.

PERCENTAGE OF TIME PRODUCER RECEIPTS OF MILK ARE A SPECIFIED PERCENTAGE OF AVERAGE



7 MILK BOTTLING PLANTS (INDIVIDUALLY AND COLLECTIVELY) IN PITTSBURGH MARKET, 1963.

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 4065-65 (12) ECONOMIC RESEARCH SERVICE

Figure 2

Table 7.--Percentage of time that milk receipts in 7 bottling plants in the Pittsburgh area were a percentage of the average for specified periods, 1963

Range, percentage of average	Percentage of time in percentage range																	
	Daily (123 days)										Weekly (16 weeks)						Monthly 1963	
	7 individual plants					7 plants combined					7 individual plants					7 plants combined	7	7
	March	May	Sept.	Dec.	4 months	March	May	Sept.	Dec.	4 months	March	May	Sept.	Dec.	16 wks.	16 wks.	individual	combined
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
.1-49.9				.9	.2													
50																		
55				.5	.1				3.2	.8								
60		.5	.5	.9	.5													
65	.5	.5	5.2	1.8	2.0													
70	.5		7.6	13.8	5.5													
75	.5	1.4	1.9	5.1	2.2				3.2	.8				14.3	3.6			
80	3.2	.5	11.4	9.7	6.2			6.7	9.7	4.1			7.1	21.4	7.1		3.6	
85	9.7	1.4	19.1	8.3	9.5			16.7	22.6	9.8			32.2	7.1	9.8	25.0	21.4	16.7
90	11.5	4.6	7.6	20.7	11.1	9.7	3.2	20.0	42.0	18.7	10.7		28.6	28.6	17.0		19.0	33.4
95	14.3	6.9	11.0	12.0	11.0	25.8		26.6	12.9	16.3	25.0	14.3	7.1	10.7	14.3	31.2	8.3	8.3
100	21.6	11.0	13.3	7.4	13.4	41.9	3.2	10.0	3.2	14.6	42.8	7.1	10.7	14.3	18.7	18.8	14.3	8.3
105	24.0	12.0	6.7	10.6	13.4	22.6	16.1	20.0	3.2	15.4	17.9	17.9	3.6	3.6	10.7	6.2	11.9	8.3
110	8.3	17.5	6.7	4.1	9.2		45.3			11.4		14.3	3.6		4.5	18.8	9.5	16.7
115	2.8	18.4	5.2	1.8	7.1		29.0			7.3	3.6	21.4	7.1		8.0		4.8	
120	1.4	7.4	2.4	.5	2.9		3.2			.8		7.1			1.8		3.6	8.3
125	1.4	7.8	1.4		2.7							17.9			4.5		2.4	
130		4.6		.9	1.4												1.2	
135	.5	1.8		.5	.7													
140		1.4			.3													
145		.9		.5	.3													
150		.9			.2													
155																		
160		.5			.1													
165+																		

variability problem is primarily one of storage and intermediate products, rather than balancing receipts and utilization.

Variation on Individual Collection Routes

Daily records of 115 bulk and 30 can collection routes serving 13 plants were analyzed to compare variation on individual routes with that at the plants. Three major factors cause variation in volumes on individual routes: Changes in the number of producers, changes in production per farm, and the pickup schedule.

These routes were considered comparable during the 4-month period. Several routes were excluded because of major reorganizations or route shifts. To this extent, variation is understated. Milk collected from the regular producers was included, regardless of its destination or use.

The individual routes had extreme daily variation in each month (fig.3). Due to every-other-day pickup from each patron the modal range for bulk routes is zero volume, but this does not distort the relative pattern. The daily curve for bulk routes tends to be flat, but the weekly distribution shows a greater central tendency, approaching a normal curve (fig. 4).

Can route collections were much more uniform, displaying a greater central tendency in volume than bulk routes, both on a daily and a weekly basis. The producers shipping in cans in this area were shipping approximately the same volume per farm as were the bulk shippers. The can routes servicing these producers did not experience the extreme seasonal fluctuation existing in some production areas.

The extreme volume variability of the individual routes emphasizes that the smaller the breakdown, the greater the degree of variability. Such variability is not simply random, but is partially random, partially from nature, and partially competitive and interrelated.

Seasonal differences are apparent in figure 3 as the mode (other than zero) moves to above-average receipts during May, falling considerably in September and December.

FLUCTUATING DEMAND

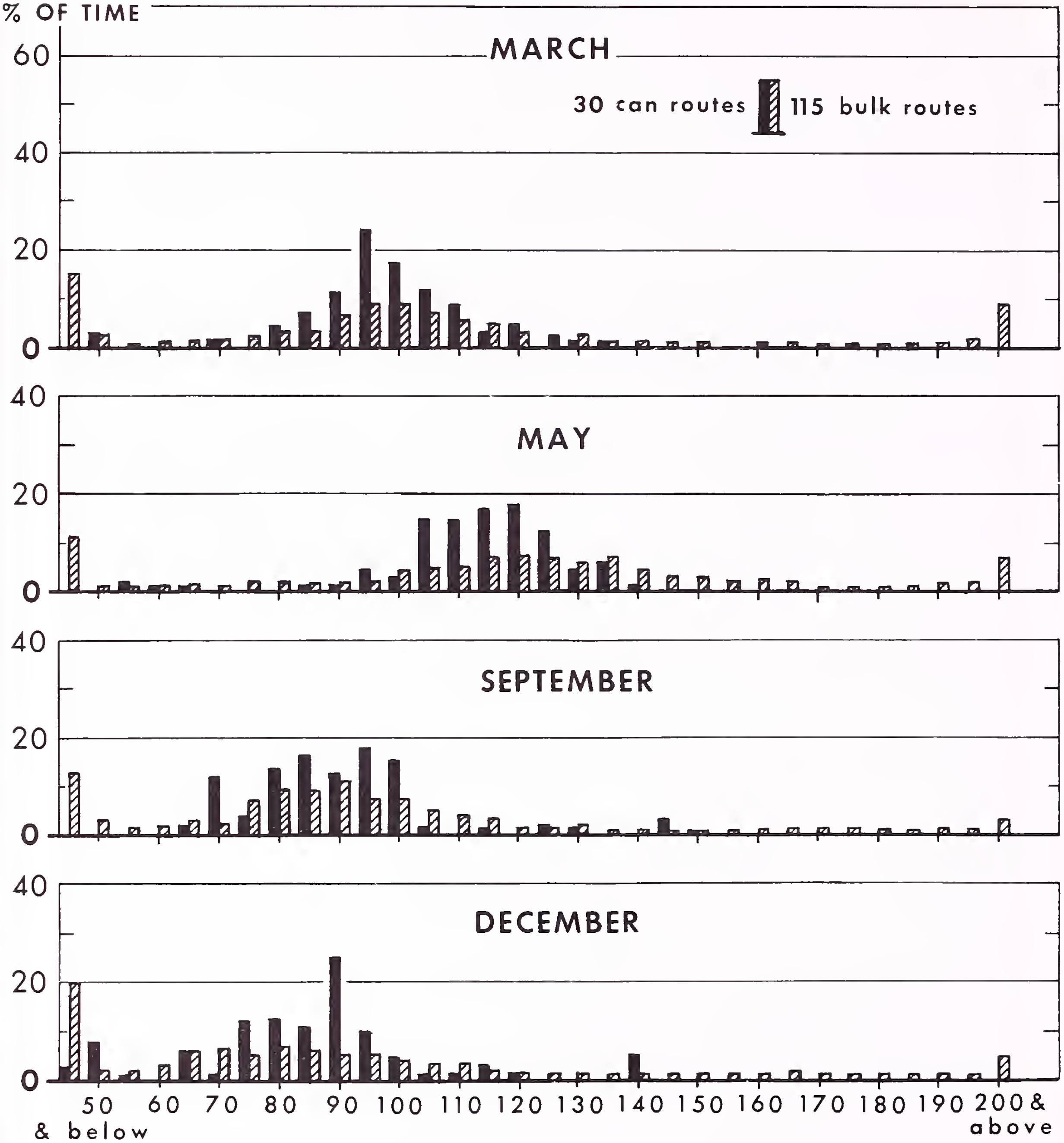
Four types of fluctuations affect demand for milk and milk products, each bearing directly upon the derived demand for raw milk:

1. Long-term changes
2. Seasonal changes
3. Periodic, within-week variations
4. Random fluctuations

Long-term changes are not within the scope of this study.

Utilization by individual plants refers to that milk actually used in processing by that plant. Bulk sales to other plants are not included in the daily or weekly plant utilization. There were some instances where it was not feasible to isolate all bulk sales for every month. The bulk shipments were then included for that plant for all monthly comparisons. Although not serious in these cases, this resulted in a somewhat exaggerated seasonal utilization pattern, compared with the weekly

PERCENTAGE OF TIME THAT PRODUCER RECEIPTS WERE A SPECIFIED PERCENTAGE OF AVERAGE ON INDIVIDUAL MILK COLLECTION ROUTES



30 CAN AND 115 BULK PICKUP ROUTES IN PITTSBURGH AREA MARCH, MAY, SEPTEMBER, AND DECEMBER, 1963.

U. S. DEPARTMENT OF AGRICULTURE

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Figure 3

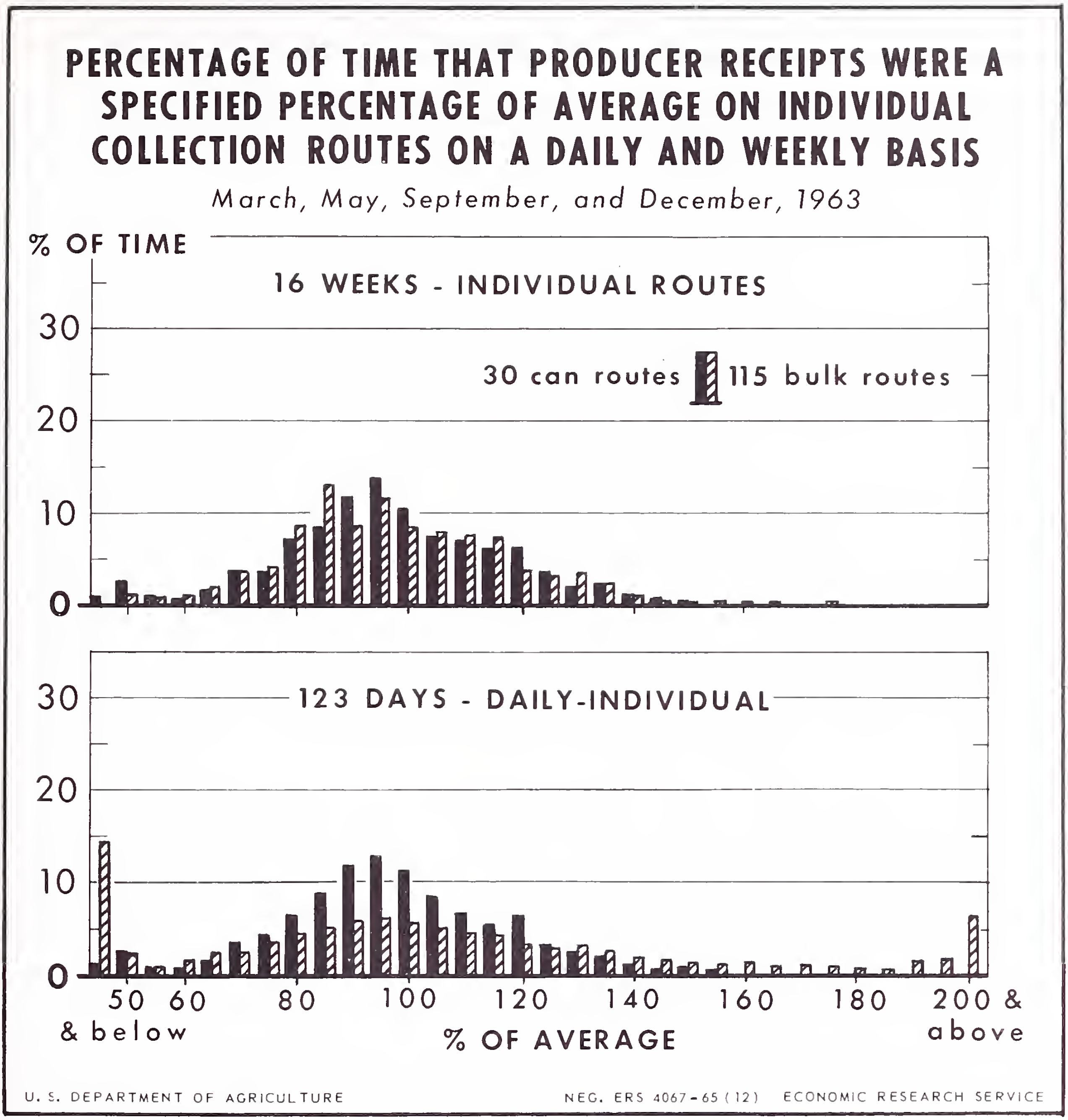
PERCENTAGE OF TIME THAT PRODUCER RECEIPTS WERE A SPECIFIED PERCENTAGE OF AVERAGE ON INDIVIDUAL COLLECTION ROUTES ON A DAILY AND WEEKLY BASIS
March, May, September, and December, 1963
% OF TIME
16 WEEKS - INDIVIDUAL ROUTES
30 can routes
115 bulk routes
30
20
10
0
123 DAYS - DAILY-INDIVIDUAL
30
20
10
0
50
& below
60
80
100
120
140
160
180
200 &
above
% OF AVERAGE
U. S. DEPARTMENT OF AGRICULTURE
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Figure 4

pattern for that plant. Some sales to other plants are included in the monthly market totals. Regular interplant transfers of packaged milk were included, but those which were made only occasionally were excluded insofar as practical.

The comparisons in this section consider the effects of varying time and plant groupings upon the variability of demand, and the reserve supply needed to meet this fluctuating demand.

Seasonal Demand

Fluid utilization was seasonally highest during the fall and winter, reaching a low point in the summer (table 8 and fig. 5). In general, this same pattern applied to the total market and to the individual plants. Some differences existed among plants due to expansion or contraction. Competitive shifts between plants caused individual volumes to fluctuate without affecting market totals (note plants A and B in June and August).

Nonfluid uses (cottage cheese, ice cream, condensed milk) are much heavier during the peak milk production periods, partly because of greater demand for cottage cheese and ice cream, and partly because of the heavier milk supply.

Plants use intermediate products to gain flexibility in operations. They may make ice cream, for example, from that day's receipts, from condensed milk, frozen cream, or butter. These intermediate products with varying storability characteristics and several alternative uses increase ability to handle fluctuations more efficiently--for the individual plant and for the market.

Daily Demand

Demand fluctuations within the week result from heavy consumer purchases over the weekend and the desire to bottle only 5 (or fewer) days per week. This variation is affected by the proportions of retail and wholesale sales, whether or not stores are open on Sunday, institutional sales, and the extent to which plants stagger their processing days. The plant utilization pattern is also affected by the type of supply coordination followed, storage capability, the degree of plant specialization, the availability of milk supplies, and surplus handling arrangements.

Table 9 depicts processing for fluid use by day of the week. The seven plants exercised responsibility for their own procurement and supply coordination, depending primarily upon producer receipts. Some had working arrangements with a cooperative, but not full supply agreements. Ten plants were serviced by cooperatives or other dealers under a full supply arrangement.

Most of the plants bottled 5 days per week and were down Sunday and Wednesday. A few bottled 6 days, some 4, and some 3 days per week. The combined volumes of these plants were much more uniform than were the individual volumes, which could not be presented without identifying the plants.

Random daily fluctuations are superimposed upon the seasonal, weekly, and within-week patterns. This type of variation is largely unpredictable as to timing and degree.

Table 8.--Daily average fluid milk use as a percentage of yearly average for 17 plants (7 regular and 10 full supply), Pittsburgh area, by months, 1963

Plant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
							Percent						
7 regular plants													
A	103	106	107	117	121	110	94	87	89	92	89	85	100
B	96	95	96	95	98	88	82	109	110	112	112	107	100
C	105	106	106	109	107	102	98	97	94	91	102	84	100
D	98	100	100	101	101	95	96	96	106	97	104	106	100
E	92	95	100	99	101	98	96	100	102	104	111	102	100
F	116	110	106	102	100	86	87	87	102	106	99	101	100
G	99	104	104	102	95	88	83	89	106	111	109	109	100
							Percentage points						
Range	24	15	11	22	26	24	14	22	21	21	23	25	---
Mean variation	5.6	5.1	3.9	5.3	5.3	8.1	9.1	7.6	6.1	7.6	7.1	8.0	---
							Percent						
7 plants combined	100	101	102	102	103	95	91	98	103	101	104	100	100
10 full supply													
H	101	96	91	91	88	89	122	102	107	109	101	104	100
I	106	99	110	107	107	87	87	89	95	109	104	99	100
J	110	104	99	108	103	92	98	92	100	104	95	98	100
K	106	102	103	104	117	110	89	92	84	96	101	98	100
L	103	103	94	104	101	89	91	91	107	112	104	102	100
M	94	98	91	94	97	77	109	100	114	115	110	100	100
N	101	100	96	106	96	96	83	108	102	107	104	103	100
O	103	102	99	106	105	74	77	76	114	120	113	112	100
P	98	94	96	100	98	96	94	104	101	106	106	105	100
Q	103	101	105	100	103	95	86	93	109	106	96	103	100
							Percentage points						
Range	16	10	19	17	29	36	45	32	30	24	18	14	---
Mean variation	4.1	2.5	5.2	5.0	5.7	11.5	12.6	8.1	7.5	9.2	5.2	3.4	---
							Percent						
10 plants combined	102	99	99	102	104	98	91	98	98	104	103	102	100
17 combined	101	101	101	102	103	95	91	98	102	102	104	101	100

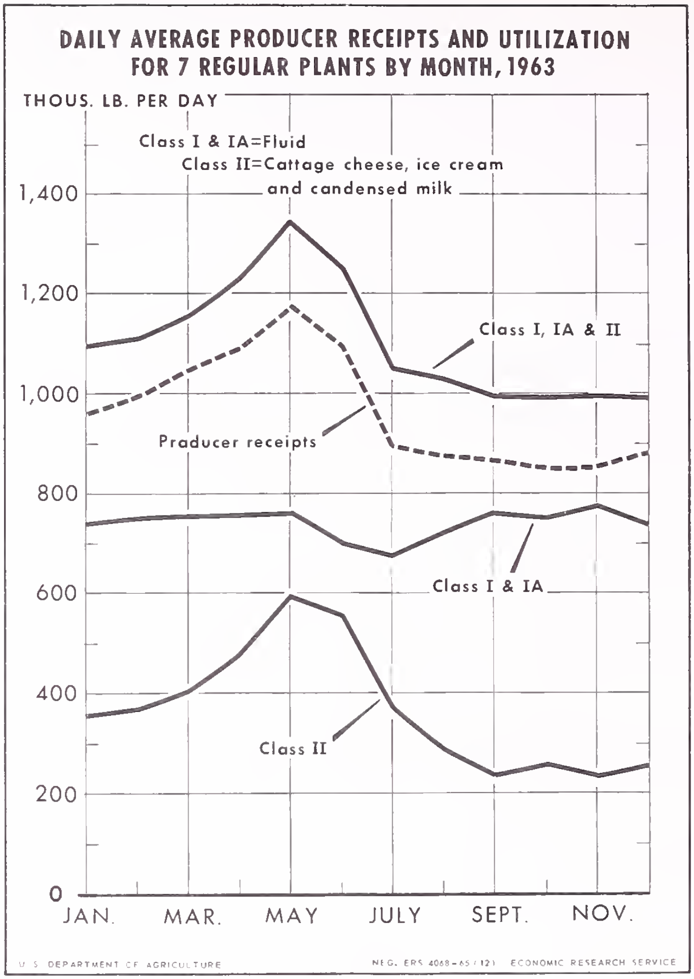

Figure 5

Table 9.--Fluid milk bottling by selected plants, percentage of average by day of week, March, May, September, December 1963 (16 weeks) 1/

Day	7 regular plants		10 full-supply plants		17 plants	
	1,000 lbs.	Percent	1,000 lbs.	Percent	1,000 lbs.	Percent
Sunday.	0	0	0	0	0	0
Monday.	1,328	105	223	127	1,551	108
Tuesday	1,479	117	217	123	1,696	118
Wednesday	495	39	52	29	547	38
Thursday.	1,471	116	239	136	1,710	119
Friday.	1,451	115	206	117	1,657	115
Saturday.	1,355	107	119	68	1,474	102
Average (6 days)	1,263	100	176	100	1,439	100

1/ Volumes for days heavily influenced by holidays were adjusted.

Table 10 shows the percentage of days that fluid use was a specified percentage of average by the plants individually and as groups. All calendar days were counted, although no plants bottled on Sunday and most were down on Wednesday and on holidays. Down days are expressed as zero utilization. Some of the 10 plants with full-supply agreements bottled only 3 or 4 days per week. This was the reason for the combined volumes showing more time in the lower volume ranges. These smaller plants were also more variable in the upper percentage brackets, so that individual plants faced greater coordinating problems at all levels than would have been true of the combined groupings.

This extreme variability from day to day is one reason for handlers using the week rather than the day as a balancing period. The handler, or some other firm, must provide facilities to effectively store, process, and market these variable amounts of milk.

Some of the 10 plants serviced under full-supply arrangements actually ordered milk on a day-to-day basis. The milk was usually delivered early in the morning and bottled that day, with no bulk carryover. Others received milk in the afternoon and stored it overnight for bottling the next day.

The 7 regular handlers generally receive producer receipts every day, although they frequently divert milk. They also receive varying quantities from affiliated and other supply plants and from other handlers. Daily storage varied tremendously--ranging from empty tanks to a 3-day supply in some instances. Most plants tried to empty their tanks on Saturday.

The amount bottled by the 10 plants averaged considerably smaller than that in the 7 regular plants. Average daily (calendar day) fluid utilization per plant was 15,256 pounds for the 10 and 105,357 pounds for the 7. This volume was approximately 40 percent of total fluid utilization in area number 2.

Weekly Demand

Weekly variations in the volume of fluid milk processed by the 7 plants are compared in table 11. Uniformity was gained by combining the volume used by the 7 plants rather than considering their individual utilization patterns. The relative gain is demonstrated by the total range and the mean variation from average weekly fluid milk utilization. The individual plants experienced up to 3 times the total range and from 1 1/2 to 5 times the mean variation of the combined utilization. The total range during the 4-month period was considerably greater than the weekly variation within the month.

The sum of the differences between high and low weekly fluid utilization was 2,006,600 pounds for the 7 individual plants. For the 7 as a combined unit this difference was 512,900 pounds--1,493,700 pounds (74.4 percent) less fluctuation between high and low weeks. Average total weekly volume was 7,579,560 pounds for the 7 plants.

Table 12 compares fluid utilization by 7 fluid milk dealers as individuals and as a combined group on a daily, weekly, and monthly basis. The volume used within each time period is expressed as a percent of that average. The variability in fluid use is compared by the percent of total time each plant grouping was in any given specified percent of average range.

At least one plant had fluid utilization within each specified range on a daily basis. Down days accounted for 22 percent of the total time on an individual daily

Table 10.--Percentage of days in March, May, September, and December 1963, that fluid use was a specified percentage of average daily fluid use for selected plants

Percentage range, average	Percentage of time in percentage range					
	Sum of 7 individual plants	7 plants combined	Sum of 10 individual plants	10 plants combined	Sum of 17 individual plants	17 plants combined
	Percent					
0.	22.4	14.6	39.1	15.5	32.2	15.0
0-49	.8	4.1		11.4	.3	7.7
50-54.	.1	4.1			.1	2.0
55-59.	.2	2.4			.1	1.2
60-64.	.2	.8	.1	6.5	.1	3.7
65-69.	.5	2.4			.2	1.2
70-74.	.5				.2	
75-79.	.7				.3	
80-84.	.7			.8	.3	.4
85-89.	1.4	.8	4.0	8.1	2.9	4.5
90-94.	2.4			.8	1.0	.4
95-99.	2.4		.1		1.1	
100-104. . . .	2.1	.8	.2	.8	1.0	.8
105-109. . . .	2.7		.4		1.3	
110-114. . . .	4.4	.8	3.9	.8	4.1	.8
115-119. . . .	5.9	4.9	2.7	.8	4.0	2.9
120-124. . . .	8.4	10.6	.5		3.7	5.3
125-129. . . .	7.6	15.5	4.0	.8	5.5	8.1
130-134. . . .	4.5	14.6	.8	3.3	2.3	9.0
135-139. . . .	6.1	13.9	2.2	9.0	3.8	11.4
140-144. . . .	6.6	7.3	1.1	17.1	3.4	12.2
145-149. . . .	4.4	1.6	1.3	2.4	2.6	2.0
150-154. . . .	4.0	1.8	1.4	2.4	2.4	1.6
155-159. . . .	3.2		5.8	5.7	4.7	2.9
160-164. . . .	2.3		4.4	8.1	3.5	4.1
165-169. . . .	.6		2.3	4.1	1.6	2.0
170-174. . . .	1.9		6.2	.8	4.4	.4
175-179. . . .	.8		3.1		2.2	
180-184. . . .	.7		1.9		1.4	
185-189. . . .	.2		2.9	.8	1.8	.4
190-194. . . .	.5		.9		.7	
195-199. . . .	.1				.1	
200-204. . . .	.1		.7		.5	
205-209. . . .	.2		1.1		.7	
210-229. . . .	.1		1.7		1.1	
230-249. . . .	.3		4.6		2.9	
250-299. . . .			2.3		1.3	
300+			.3		.2	

Table 11.--Weekly fluid milk use in March, May, September, and December, 1963 as a percentage of the 16-week average for 7 bottling plants in the Pittsburgh area

Period	Plant A	Plant B	Plant C	Plant D	Plant E	Plant F	Plant G	Combined 7 plants	Mean variation
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Percentage points
March:									
1st week	100	93	102	104	96	100	91	100	3.8
2nd week	94	92	103	102	100	98	99	98	3.2
3rd week	100	92	115	103	96	98	98	103	5.0
4th week	102	92	112	103	101	98	96	102	4.4
Range	8	1	13	2	5	2	8	5	---
May:									
1st week	126	92	92	102	103	102	104	103	7.6
2nd week	122	91	90	100	95	98	90	100	8.3
3rd week	122	90	92	97	95	100	102	100	7.1
4th week	115	90	85	97	97	96	100	97	7.1
Range	11	2	7	5	8	6	14	6	---
September:									
1st week	94	106	112	100	104	113	104	104	6.5
2nd week	96	107	106	104	97	108	101	103	4.8
3rd week	92	112	105	100	101	102	105	102	4.7
4th week	93	111	105	89	100	99	105	99	5.8
Range	4	6	7	15	7	14	4	5	---
December:									
1st week	93	110	94	105	105	96	103	100	5.7
2nd week	92	112	89	103	106	103	100	99	6.3
3rd week	84	109	101	103	110	98	102	100	6.2
4th week	75	98	96	89	94	90	100	90	8.4
Range	18	14	12	16	16	13	3	10	---
				Percentage points					
Total range	51	22	30	16	16	17	15	14	---
Mean variation	10.9	8.6	7.6	3.6	3.9	3.7	3.4	2.2	---

Table 12.--Percentage of time that fluid milk use by 7 bottling plants in the Pittsburgh area were a percentage of the average, specified periods, 1963

Range, percentage of average	Percentage of time in specified percentage of average range																	
	Daily (123 days)										Weekly (16 weeks)						Monthly 1963	
	7 individual plants					7 plants combined					7 individual plants					7 plants combined	7	7
	March	May	Sept.	Dec.	4 months	March	May	Sept.	Dec.	4 month	March	May	Sept.	Dec.	16 wks.	16 wks.	individual	combined
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
0	22.6	19.8	22.9	24.3	22.4	12.9	12.9	16.7	16.1	14.6								
.1-49.9		.5	1.4	1.4	.8	3.2			12.9	4.1								
50			.5		.1	9.7		6.7		4.1								
55			.5	.5	.2		3.2	6.7		2.4								
60			.5	.5	.2		3.2			.8								
65		.9		.9	.5		9.7			2.4								
70	.5	.9		.5	.5													
75		1.8	.5	.5	.7									3.6	.9			
80	.5	.9		.9	.7									3.6	.9		3.6	
85	.9	2.8	.9	.9	1.4	3.2				.8		7.1	3.6	10.7	5.4	6.3	11.9	
90	2.3	1.4	2.8	3.2	2.4						21.4	32.1	10.7	14.3	19.6		6.0	16.7
95	3.2	3.7	.5	2.3	2.4						39.3	17.9	14.3	14.3	21.4	37.5	22.6	8.3
100	.9	2.8	2.8	1.4	2.1			3.3		.8	32.1	28.6	32.1	32.1	31.3	56.2	26.2	75.0
105	1.4	2.8	4.3	2.3	2.7								25.0	10.7	8.9		19.0	
110	3.2	4.6	4.3	4.6	4.4			3.3		.8	3.6	3.6	14.3	10.7	7.1		7.1	
115	6.9	8.7	7.1	3.7	5.9	3.2	6.5		9.7	4.9	3.6	7.1			1.8		2.4	
120	11.0	6.5	7.6	9.2	8.4	16.1	19.4		6.5	10.6		3.6			1.8		1.2	
125	11.5	7.8	6.7	6.0	7.6	9.7	16.1	16.7	19.4	15.5					.9			
130	5.1	2.8	8.1	3.7	4.5	19.4	12.9	13.3	12.9	14.6								
135	9.2	7.8	2.8	4.6	6.1	12.9	12.9	16.7	12.9	13.9								
140	8.7	6.0	6.2	7.8	6.6	9.7	3.2	13.3	3.2	7.3								
145	4.6	1.8	5.3	5.1	4.4			3.3	3.2	1.6								
150	2.3	4.6	4.8	4.6	4.0				3.2	.8								
155	2.8	4.6	1.4	4.1	3.2													
160	.9	3.2	2.4	.9	2.3													
165	.5	.5	.9		.6													
170		.9	.9	3.2	1.9													
175	.5	.5	.5	1.4	.8													
180	.5	.9	.9	.5	.7													
185		.5	.5	.5	.2													
190					.5													
195			.5		.1													
200				.5	.1													
205			.5		.2													
210			.5		.1													
230			.5		.3													
250+																		

period. This does not adversely affect the comparative relationship, but does cause the modal range to be above the average daily utilization.

On a daily basis, the 7 plant volumes combined were between 115 and 144 percent of average 66.8 percent of the time, compared with 39.1 percent as individual plants. Adding the down days, the percentages were 81.4 and 61.5 respectively. The relatively larger cluster of the combined group in the lower volume ranges resulted from some plants operating on Wednesdays when the others were down.

The amount of reserve necessary to meet the variable fluid milk needs was significantly greater for individual plants than when they were combined. Fluid use for the 7 plants combined was below 140 percent of average for approximately 90 percent of the days. The individual plants would have needed over 155 percent of their average volume to include 90 percent of the days.

The weekly volume utilized as fluid milk by the 7 plants combined was extremely stable, falling between 95 and 104 percent of average nearly 94 percent of the time. The individual plant volumes were more variable, falling within this narrow range slightly over one-half the time. There was little difference in the variability of weekly fluid milk use by the combined 7 plants during the 16 weeks on a monthly basis for the entire year.

Based upon average utilization, no week would have required more than a 5-percent reserve for fluid variation for the 7 combined. A 5-percent reserve would have left the individual plants short 20 percent of the time, and a 10-percent reserve would have satisfied needs for only 95 percent of the weeks. A 20-percent individual reserve would have met their fluid needs 99 percent of the time.

Based on the monthly accounting period, the combined fluid used by the 7 plants was always between 90 and 104 percent of average. The 7 as individuals were outside this range almost one-half the time (below 15.5 percent of the time and above 30.7 percent). Individual plant fluid milk use was at least 10 percent greater than average 10.7 percent of the time. A 20-percent reserve would have covered the individual monthly fluid variations 99 percent of the time.

Central tendency is increased and variability decreased by combining the volumes and by lengthening the time period. This is especially marked with daily and weekly comparisons as shown in figure 6.

These variations and reserves are based only upon the fluid utilization. Fluctuating producer receipts and the interaction between the supply and demand are considered separately.

BALANCING SUPPLY WITH DEMAND

In meeting a fluctuating demand with a variable supply, each dealer must carry a reserve adequate to meet the extreme individual fluctuations to the degree desired. A central coordinator supplying several plants can take advantage of the offsetting fluctuations within the group. A central coordinator needs reserves to provide for net fluctuations, whereas individual management results in considerable duplication of reserves.

While these comparisons are based upon a balance between supply and demand for fluid milk at the season of relatively short supply, the same principle and measures

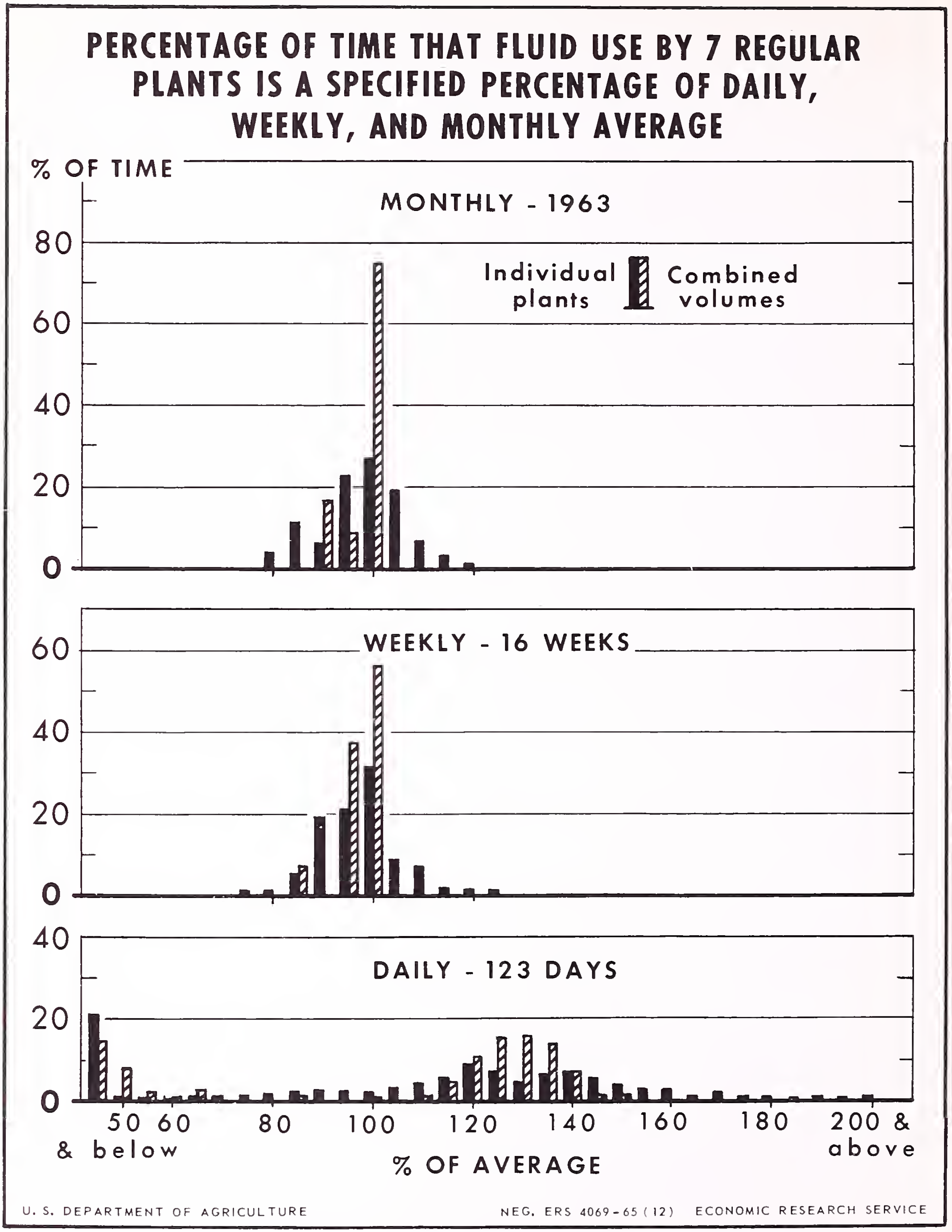
PERCENTAGE OF TIME THAT FLUID USE BY 7 REGULAR PLANTS IS A SPECIFIED PERCENTAGE OF DAILY, WEEKLY, AND MONTHLY AVERAGE
% OF TIME
MONTHLY - 1963
Individual plants
Combined volumes
80
60
40
20
0
WEEKLY - 16 WEEKS
60
40
20
0
DAILY - 123 DAYS
40
20
0
50 & below
60
80
100
120
140
160
180
200 & above
% OF AVERAGE
U. S. DEPARTMENT OF AGRICULTURE
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Figure 6

are applicable to a "balance" at some other level or time. The desired level may be a supply to provide for all fluid milk, ice cream, and cottage cheese, or for satisfaction of fluid demand 90 percent of the time, or for 120 percent of fluid demand during a certain month. These comparisons may be made using the appropriate desired balance as the base which would indicate the resultant surpluses and shortages.

This section considers how varying the time period and the level at which supply is coordinated with demand affects the necessary reserve supply. These effects are expressed in terms of how this reserve contributes to surplus above fluid utilization at the different supply management levels. The sources of surplus are measured in terms of fluctuations in utilization, in producer receipts, and the ratio of producer receipts to fluid utilization.

Sources of Weekly Surplus

The sources of the weekly surplus arising from volume flucutations at each of the 7 individual plants and the 7 combined are compared in table 13. For each plant the first column shows the percentage of the plant's surplus milk resulting from using less fluid milk in that week than it did during the week of peak demand--the surplus from variations in fluid demand. Producer receipts also fluctuated from week to week during the 4-month period. The second column shows the quantity by which weekly producer receipts exceeded those of the lowest week.

These computations show how the fluctuations in supply and demand affect surplus. Year-round surplus is not measured by this method, which may overstate or understate actual surplus. The relative importance of each fluctuation during the 4 months is indicated by the last line in each column.

Fluid utilization for the 7 individual plants varied significantly more than for the 7 combined. Changes in individual fluid utilization were more abrupt and extremes more shortlived than those in producer receipts. The 16-week comparison shows 52 percent of the individual plant surplus due to fluctuating fluid utilization, whereas the fluctuations in fluid use for the 7 combined accounted for only one-half of this (26 percent). For the individual plants, variation in fluid utilization was slightly greater than that in producer receipts. For the 7 combined, the volume of surplus from variation in weekly producer receipts was 3 times as great as that from fluid use.

Combining the 7 plant volumes resulted in 25 percent as much surplus from variation in fluid use and 79 percent as much surplus from variations in producer receipts as was shown by considering the 7 plants individually. The total computed 16-week surplus for the 7 plants as individuals was 32,930,000 pounds. For the 7 combined, the surplus was 16,692,000 pounds, a difference of 16,238,000 pounds. Nearly twice as much surplus resulted from the variations in individual supply and demand as in the combined volumes, indicating that proportionately less reserve would be needed for the combined than for the 7 individual plants.

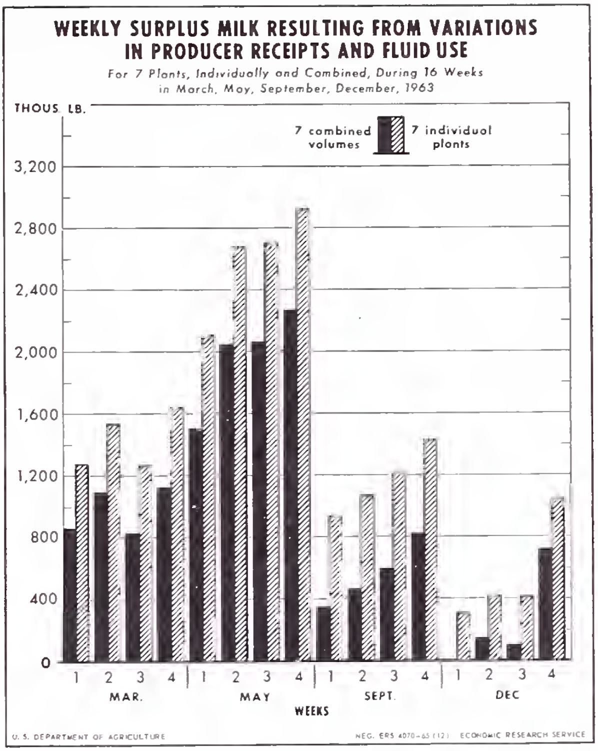
Figure 7 compares the surplus resulting from the interacting variation in producer receipts and fluid utilization (not the actual surplus). This measure was obtained by adjusting producer receipts so that they were equal to fluid use in the week when receipts were relatively short compared to fluid use.

The ratio of producer receipts to fluid milk use at its lowest point then would be 100. Weekly producer receipts then were adjusted to maintain the actual pattern.

Table 13.--Weekly surplus milk at 7 bottling plants in the Pittsburgh area, expressed as the percentage of that week's surplus arising from fluctuations in fluid use and in producer receipts during March, May, September, and December 1963

Period	Plant A		Plant B		Plant C		Plant D		Plant E		Plant F		Plant G		Sum of 7 individual plants Percentage of surplus		7 plants combined Percentage of surplus		Sum of 7 individual plants			7 plants combined		
	From fluid 1/	From producer receipts 2/	From fluid 1/	From producer receipts 2/	From fluid 1/	From producer receipts 2/	From fluid 1/	From producer receipts 2/	From fluid 1/	From producer receipts 2/	From fluid 1/	From producer receipts 2/	From fluid 1/	From producer receipts 2/	From fluid	From producer receipts	From fluid	From producer receipts	From fluid	From producer receipts	Total surplus	From fluid	From producer receipts	Total surplus
	Percent																		1,000 pounds					
March:																								
1st week	66	34	88	12	49	51	17	83	27	73	26	74	62	38	55	45	30	70	1,105	894	1,999	296	689	985
2nd week	66	34	79	21	48	52	34	66	18	82	26	74	33	67	54	46	33	67	1,199	1,004	2,203	392	799	1,191
3rd week	63	37	78	22	0	100	28	72	22	78	24	76	28	72	45	55	6	94	866	1,068	1,934	58	863	921
4th week	58	42	55	45	19	81	26	74	15	85	24	76	35	65	41	59	7	93	889	1,287	2,176	81	1,081	1,162
May:																								
1st week	0	100	66	34	47	53	48	52	8	92	16	84	7	93	34	66	2	98	840	1,653	2,493	32	1,447	1,479
2nd week	12	88	62	38	44	56	62	38	13	87	18	82	56	44	36	64	13	87	1,062	1,907	2,969	254	1,703	1,957
3rd week	13	87	63	37	42	58	76	24	14	86	15	85	12	88	36	64	13	87	1,075	1,926	3,001	267	1,721	1,988
4th week	26	74	63	37	48	52	100	0	12	88	21	79	14	86	41	59	23	77	1,321	1,884	3,205	513	1,679	2,192
September:																								
1st week	98	2	41	59	12	88	69	31	23	77	0	100	50	50	53	47	0	100	809	711	1,520	0	506	506
2nd week	88	12	69	31	24	76	32	68	49	51	52	48	75	25	52	48	6	94	840	772	1,612	33	567	600
3rd week	84	16	100	0	25	75	53	47	44	56	75	25	100	0	52	48	14	86	909	830	1,739	102	624	726
4th week	94	6	62	38	24	76	74	26	55	45	100	0	0	100	58	42	34	66	1,130	826	1,956	322	621	943
December:																								
1st week	98	2	76	24	97	3	0	100	100	0	55	45	14	86	84	16	100	0	1,072	206	1,278	265	0	265
2nd week	100	0	0	100	100	0	17	83	30	70	38	62	42	58	83	17	90	10	1,171	244	1,415	363	38	401
3rd week	97	3	58	42	90	10	36	64	0	100	46	54	12	88	81	19	86	14	1,105	252	1,357	296	49	345
4th week	98	2	92	8	88	12	100	3/ 0	57	43	50	50	24	76	89	11	100	3/ 0	1,839	234	2,073	1,031	0	1,031
16 weeks	67	33	67	33	45	55	56	44	20	80	29	71	29	71	52	48	26	74	17,232	15,698	32,930	4,305	12,387	16,692

1/ Based upon fluid use in high week minus fluid use for each week. Percentage in column 1 plus column 2 equals 100 percent of the surplus for that week.
2/ Based upon actual weekly producer receipts minus producer receipts in low week.
3/ Adjusted because of holiday influence.


WEEKLY SURPLUS MILK RESULTING FROM VARIATIONS IN PRODUCER RECEIPTS AND FLUID USE

For 7 Plants, Individually and Combined, During 16 Weeks in March, May, September, December, 1963

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 4070-65 (12) ECONOMIC RESEARCH SERVICE

Figure 7

Actual fluid use was subtracted from adjusted producer receipts to obtain this surplus.

Basing the surplus upon adjusted producer receipts permits direct comparison of the several plants. Differences due to some plants carrying a higher ratio of producer receipts to fluid utilization are avoided by balancing at the low point.

The resulting surplus for 16 weeks was 22.9 million pounds for the 7 as individuals and 14.9 million pounds for the 7 as a combined unit. The difference was 8.0 million pounds, a 35.0 percent reduction. The 16-week surplus for the individual plants was 18.9 percent of total fluid use, while for the 7 combined it was 12.3 percent.

Sources of Seasonal Surplus

Based upon a daily average by months for the entire year 1963, producer receipts (962,100 pounds) for the 7 plants averaged 224,600 pounds per day greater than fluid utilization (737,500). This difference was equal to 30.5 percent of fluid use and 23.3 percent of producer receipts.

Lowest production was reached in October when producer receipts averaged 842,500 pounds per day. May production was highest with an average of 1,175,700 pounds, 333,200 pounds per day above the October low--a 39.5 percent increase. The total marketed increased by 28.2 percent.

Fluid use by the 7 plants reached a peak in November, with a daily average of 769,700 pounds. The low was in July, when 670,700 pounds were used per day, a decline of 99,000 pounds, or 12.9 percent. The decline was 11.7 percent for the entire market area.

The surplus of producer receipts above fluid use by the 7 plants combined reached a maximum of 418,900 pounds per day in May and a low of 75,400 pounds per day in November. This low point may be considered the year-round surplus for these 7 plants combined.

Monthly fluctuations in producer receipts and in fluid use as sources of surplus are compared in table 14. The 7 plants considered as individuals had a daily average for the year of 141,300 pounds surplus due to variations in producer receipts, compared with 119,600 pounds when the volumes of the 7 plants were combined. The comparable figures for fluid use were 80,800 and 32,200 pounds. The differences were 21,700 pounds in producer receipts and 48,600 in fluid use, favoring the combined volumes.

Competitive shifts are emphasized in table 14 by comparing the percentage of the surplus for the month contributed by each source of variation. One-third of the surplus was due to changes in fluid utilization for the 7 individual plants, while only one-fifth that of the 7 combined resulted from this source. This difference is even more marked in the weekly comparisons (table 13). Monthly producer receipts varied more than fluid utilization. However, variation would be decreased relatively more from combining the fluid utilizations than from combining the producer receipts.

Producer Receipts as a Percentage of Fluid Use

The net effect of all fluctuations upon the supply-demand balance is reflected by the measure of producer receipts as a percentage of fluid use (table 15). Producer receipts were adjusted to equal fluid utilization during the week when supply for each plant was lowest compared with fluid use. Producer receipts for each week were then adjusted to conform to the pattern actually experienced and compared with actual fluid use.

A dealer could apply the percentage figures shown in table 15 to whatever ratio he desired to achieve during the period when the ratio of producer receipts to fluid use was low, or any other base period. This would indicate the net effect of fluctuating producer receipts and fluid utilization and reveal each surplus and shortage he would have experienced. The table also indicates the ratio needed on a monthly basis in order to achieve a balance in the short week.

Monthly producer receipts were adjusted in this same manner (table 16). Actual producer receipts for these 7 plants were approximately 10 percent greater for the year than the adjusted receipts. Actual producer receipts as a percent of their fluid use for the 7 plants combined ranged from 110 in November to 156 in June. Some of the plants actually carried considerable reserve, while producer receipts were less than fluid utilization at least part of the time at other plants.

These measures, together with other patterns of fluctuation, need to be considered when ascertaining the proportion of the milk supply to carry as reserve. Timing is as much a part of the problem as is the volume variation.

Monthly Accounting Period and Weekly Operating Period

Fluid milk dealers normally use the month as an accounting period but the week as an operating period. They strive to complete the week with no unprocessed

Table 14.--Fluctuating producer milk receipts and fluid use as percentage of surplus in 7 bottling plants in the Pittsburgh area, daily average by months, 1963

Plant	January		February		March		April		May		June	
	Percent of surplus associated with variation in		Percent of surplus associated with variation in		Percent of surplus associated with variation in		Percent of surplus associated with variation in		Percent of surplus associated with variation in		Percent of surplus associated with variation in	
	Producer receipts	Fluid use	Producer receipts	Fluid use	Producer receipts	Fluid use	Producer receipts	Fluid use	Producer receipts	Fluid use	Producer receipts	Fluid use
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
A	60	40	71	29	79	21	95	5	100	0	89	12
B	45	55	45	55	52	48	55	45	64	36	47	53
C	82	18	88	12	92	8	100	0	97	3	91	9
D	70	30	80	20	82	18	82	18	84	16	64	36
E	47	53	65	35	81	19	83	17	90	10	84	16
F	100	0	79	21	76	24	70	30	72	28	46	54
G	64	36	78	23	78	22	78	22	68	32	38	62
Sum of 7 individual plants	64	36	70	30	76	24	81	19	85	15	70	30
7 plants combined	79	21	87	13	91	9	94	6	96	4	78	22
	Volume: Daily average surplus by month associated with variation											
	100 pounds											
Sum of 7 individual plants	1,396	791	1,684	714	2,232	691	2,654	634	3,549	615	2,714	1,191
7 plants combined	1,179	305	1,467	228	2,015	205	2,437	148	3,332	129	2,497	705

Plant	July		August		September		October		November		December		Yearly average	
	Percent of surplus associated with: variation in:		Percent of surplus associated with: variation in:		Percent of surplus associated with: variation in:		Percent of surplus associated with: variation in:		Percent of surplus associated with: variation in:		Percent of surplus associated with: variation in:			
	Producer receipts	Fluid use	Producer receipts	Fluid use	Producer receipts	Fluid use	Producer receipts	Fluid use	Producer receipts	Fluid use	Producer receipts	Fluid use	Producer receipts	Fluid use
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
A	33	67	21	79	26	74	23	77	0	100	22	78	63	37
B	23	77	60	40	61	39	0	100	100	0	42	58	48	52
C	73	27	61	39	44	56	0	100	0	100	18	82	76	24
D	27	73	0	100	98	2	28	72	72	28	100	0	69	31
E	24	76	62	38	61	39	3	97	0	0	42	58	73	27
F	20	80	22	78	28	72	0	100	22	78	50	50	52	48
G	0	100	15	85	72	28	100	0	93	7	94	6	64	36
Sum of 7 individual plants	34	66	34	66	44	56	23	77	33	67	44	56	64	36
7 plants combined	35	65	36	64	72	28	0	100	100	0	57	43	79	21
	Volume: Daily average surplus by month associated with variation													
	100 pounds													
Sum of 7 individual plants	756	1,476	504	986	453	578	217	717	243	486	608	781	1,413	808
7 plants combined	539	990	287	500	236	92	0	231	26	0	391	295	1,196	322

Table 15.--Adjusted producer milk receipts by 7 bottling plants in the Pittsburgh area, as percentages of actual fluid utilization by weeks, March, May, September, and December, 1963 1/

Period	Plant A	Plant B	Plant C	Plant D	Plant E	Plant F	Plant G	Sum of 7 individuals	7 plants combined
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
March:									
1st week.........	114	125	119	105	139	133	124	117	111
2nd week.........	128	132	117	105	137	138	118	121	115
3rd week.........	119	132	107	105	145	139	125	116	111
4th week.........	120	154	111	106	140	141	125	121	114
Four weeks.......	120	136	113	105	140	138	123	119	113
Range, high-low	14	29	12	1	8	8	7	5	4
May:									
1st week.........	112	142	153	104	151	139	116	127	119
2nd week.........	120	147	167	104	177	151	130	135	127
3rd week.........	119	151	162	108	176	150	128	136	127
4th week.........	125	149	180	105	168	153	133	140	131
Four weeks.......	119	148	166	105	168	148	127	134	126
Range, high-low	13	9	27	4	26	14	17	13	12
September:									
1st week.........	100	121	122	105	116	100	104	112	104
2nd week.........	104	108	139	100	121	105	105	114	106
3rd week.........	112	100	142	105	115	111	100	116	108
4th week.........	103	102	146	121	114	113	100	119	111
Four weeks.......	105	108	137	107	116	107	102	115	107
Range, high-low	12	21	24	21	7	13	5	7	7
December:									
1st week.........	102	103	105	102	105	125	118	104	100
2nd week.........	102	101	110	106	109	117	112	106	102
3rd week.........	112	107	100	101	100	124	124	106	101
4th week.........	127	117	107	110	125	138	119	115	111
Four weeks.......	110	106	105	104	109	125	118	108	103
Range, high-low	25	16	10	9	25	21	12	11	11
16-week range....	28	54	80	21	77	53	33	40	31

1/ Producer receipts adjusted to equal fluid utilization during week of lowest ratio and to correspond with pattern of variation actually experienced.

Table 16.--Adjusted producer milk receipts at 7 bottling plants in the Pittsburgh market as a percentage of fluid utilization by months, 1963 1/

Plant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
A	100	102	110	111	118	121	102	108	107	102	101	111	108
B	140	142	146	154	161	170	156	110	106	100	100	111	131
C	111	114	122	125	146	145	126	119	116	110	100	125	122
D	129	127	132	130	135	131	113	108	100	110	105	105	118
E	132	134	138	150	164	155	118	120	116	107	100	113	128
F	108	117	125	132	142	152	129	130	109	100	112	118	122
G	114	110	112	118	130	122	115	111	100	101	106	110	112
7 individual plants	123	124	130	133	143	144	125	113	106	105	103	112	122
7 plants combined	118	121	127	131	142	142	122	110	104	103	100	108	119

1/ Producer receipts adjusted to equal fluid utilization during month of lowest ratio and to correspond with pattern of variation actually experienced.

milk in storage. Relative variations are greater from week to week than monthly. In a limited time, the weekly variations tend to approach a normal distribution more closely than do the monthly variations.

If each dealer balanced supply with fluid utilization for the month when the ratio (producer receipts/fluid use) was lowest, there would be a surplus for each remaining month. There also would be some weeks when producer receipts were below fluid utilization. Dealers could meet these weekly shortages by carrying a reserve supply or by securing extra milk from supplementary sources.

These relationships are summarized in table 17 for 7 plants as individuals and as a combined unit. The number of weeks with shortages during March, May, September, and December 1963 are shown for varying reserve ratios.

Balancing producer receipts at individual plants with fluid use in the short month would have left the 7 dealers short a total of 28 weeks during the 4 months (7 x 16 = 112 weeks). In these 4 months, these dealers would have needed 862,000 pounds from supplementary supplies and would have had a surplus of 17.4 million pounds.

For practical purposes, the individual plants would have needed a ratio of producer receipts to fluid utilization of 107 during the low month to meet all weekly fluid utilization needs. The 7 plants combined would have needed a ratio of 103. This does not indicate that a 3-percent reserve in the low month is ideal. It does indicate that 3 percent would have met the market's needs with a coordinated supply as adequately as 7 percent would have met the needs with individual procurement systems. Some handlers and some markets would desire to base such comparisons on fluid utilization; others on fluid, ice cream, and cottage cheese utilization, or some different combination.

With total fluid use of 269 million pounds in 1963, these 7 dealers operating individually would have added another 3.4 million pounds to the yearly surplus for each 1-percent reserve in the low month. The 7-percent reserve needed in the low month to meet all individual weekly fluid use would have resulted in a total of 78.5 million pounds of surplus for the year.

Had these 7 plants individually maintained a 5-percent reserve in the low month, they would have been short 5 weeks in the 4-month period. They would have needed 162,000 pounds from other sources for the year and would have added 18.2 million pounds to the year-round surplus.

A lower reserve ratio would have satisfied the weekly fluid needs if the 7 plants were serviced by a central coordinating agency. A monthly balance between receipts and fluid utilization would have left the combined group short 3 weeks in the 4-month period. The yearly shortage would have been 1.5 million pounds with 33.4 million pounds of surplus. With a 1-percent reserve, the combined group would have been short 3 weeks, at the rate of 810,000 pounds for the year. This would have added another 1.1-million pounds of surplus. A 3-percent monthly reserve would have met the weekly fluid needs of the combined group but would have added 10.5-million pounds to the surplus existing with a monthly balance, resulting in approximately 43.8-million pounds of surplus for the year.

Dealers and managers of producers' cooperatives often express the opinion that they cannot afford to be short at any time because of the high cost of supplementary supplies. Generally, only a small part of the total needs would be obtained from

Table 17.--Effects of variation in relationships between milk receipts and fluid use on reserves, shortages, and surpluses in 7 bottling plants in the Pittsburgh area, March, May, September, and December, 1963

Ratio of producer milk receipts to fluid use in the low month (percent)	Weeks with shortages		Quantity needed from outside during shortages		Reserves added to basic surplus, by weeks		Total surplus, 4 months	
	Sum of 7 plants	7 plants combined	Sum of 7 plants	7 plants combined	Sum of 7 plants	7 plants combined	Sum of 7 plants	7 plants combined
	Weeks	Weeks	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds
95	43	6	3,200	2,198	---	---	12,827	6,240
99	29	3	1,195	712	---	---	16,333	10,031
100	28	3	862	491	---	---	17,378	11,129
101	18	3	628	270	1,143	1,097	18,521	12,226
102	17	3	431	98	2,324	2,246	19,702	13,375
103	13	1	250	20	3,522	3,487	20,900	14,616
105	5	0	54	0	6,081	6,105	23,459	17,234
107	1	0	6	0	8,789	8,743	26,167	19,872
110	0	0	0	0	12,917	12,700	30,295	23,829

1/ Reserve expressed by producer receipts as a percentage of fluid use in month when ratio was low. Ratio of 100 = no reserve; 101 = 1 percent reserve, etc. The producer receipts for the 4 months were 34.8 percent of the yearly total, fluid use was 34.3 percent and Class II use (cottage cheese, ice cream, condensed milk) 34.5 percent. Yearly totals in shortages and surpluses would have been approximately triple those shown in this table.

supplementary supplies. The net cost of this relatively small volume should be weighed against the effective costs of producing, handling, and marketing the increased surplus resulting from higher reserves.

These comparisons are not intended to specify what ratio should be maintained between producer receipts and fluid use. The most satisfactory ratio will depend upon the interrelationships of several variables in each market. These relationships may be useful to procurement personnel in ascertaining the proper ratio and form of supply management for their operation. The comparisons do suggest that every handler in every market need not meet all his needs with producer receipts. There are effective alternatives for the handlers and for the separate markets. The reserve provided by any level of supply management is not carried just during the short period, but magnifies the surplus problem all the rest of the year. Dealers, individually or collectively, may find it more advantageous to buy supplementary supplies for 1 to 5 percent of their needs for a brief period than to carry the extra surplus burden 50 weeks a year.

Methods Used to Balance Supply with Demand

Plant managers employ several devices to secure a more desirable balance between supply and demand. Full-supply agreements with another firm are becoming more common as plants tend toward greater specialization and greater volume.

Managers alter the rate of milk flow through the assembly-processing-distribution complex to gain timeliness. Bulk storage is practiced by most plants, even when supply and demand are balanced closely. The plant operation can be planned more effectively when the day's operations are started with supplies received the previous day, thereby minimizing or avoiding entirely disruptions due to delayed receipts.

The contraseasonal pattern between supply and demand for fluid milk leads to increased seasonal manufacture of cottage cheese and ice cream with accompanying price specials and merchandising.

To dispose of surplus supplies, milk frequently is diverted to manufacturing plants, especially on a short-term basis. Obtaining supplementary supplies from a nearby source or from outside the regular milkshed is the corollary to diversions. Handlers generally combine these two practices, often working with a supply-manufacturing plant eqipped to handle fluctuating volume. This permits gearing the entire marketing operation to "normal" conditions, rather than basing it upon extremes of either supply or demand.

Manufacturing excess milk into intermediate or final products by the fluid handler is a common method of achieving a balance, but this practice is less significant than formerly. Manufacturing plants now usually absorb excess surplus and sell intermediate products to the fluid handlers as they are needed.

Some handlers find it advantageous to purchase significant volumes of intermediate products for use in ice cream and cottage cheese. Volumes and timing of such products can be varied more readily than fluid milk supplies. A saving in transportation may be made when milk must be moved some distance.

Some dealers use school contracts to seek a more uniform utilization throughout the week. This can be especially helpful to plants with heavy weekend sales through supermarkets.

Seasonal price incentives have been used very effectively by certain handlers in the Pittsburgh market. These include quota plans, and seasonal premiums or discounts applied in such a manner as to influence production in the desired direction. Field service oriented toward achieving a desirable seasonal production pattern has been used by some plants. These activities normally do not solve the immediate short-term imbalances between supply and demand.

Some dealers were not overly concerned with the seasonality problem as they were in a position to obtain extra supplies or to dispose of surplus milk rather easily or to handle the surplus at a profit. Others were very concerned and were employing various means to influence producers to provide a more uniform supply.

Diversions and Extra Receipts

Handlers and producers' cooperatives divert milk and purchase extra supplies to bring supply into balance with utilization. This permits a greater operating flexibility at lower cost than if each handler processed all his producer receipts and carried a regular supply to provide all his needs. Those with a full-supply arrangement simply indicate the quantity of milk they desire; the supplier is responsible for handling any imbalance.

The volume of milk actually delivered to handlers for processing varies more than producer receipts on a short-term basis, but less on a seasonal basis. Since the handler controls his actual total receipts, these fluctuations are primarily to enhance his ability to serve his market. Much of this short-term fluctuation is to meet the weekend rush with a 5-day bottling week.

If the supply is short and supplementary supplies not economically available, handlers usually will receive all the producer receipts and adjust the processing and storage schedule to build up the inventory gradually during the week. With heavy supplies, handlers frequently divert all or a part of the milk on certain days, accepting delivery at the plant as best suits their operations.

Extra receipts are those purchases of raw milk in addition to producer receipts and regular receipts from other sources. When plants bring in these extra receipts--normally shipped in large tank trucks--total daily receipts fluctuate markedly. The plant rotates temporary storage so as to minimize disruptions to the processing schedule.

In a market where most plants do not process on Sunday or Wednesday, supplies would be more readily available on these two days and on Saturday. Thus, both diversions and extra receipts might be greatest at the same time. This limitation would not apply to the same degree in a market with consistently large volumes of surplus milk.

Diversions and extra receipts by 14 selected plants are summarized by day of the week in table 18. Diversions were heaviest on Saturday, averaging 163 percent of those made on Wednesday, the low day. Extra receipts were heaviest on Friday and lightest on Sunday and Monday.

Tables 19 and 20 compare the number of days that plants diverted milk and purchased extra supplies of raw milk in each of the 4 months. During the 123 days, the 14 plants diverted milk to surplus manufacturing uses 756 times on 123 different days and purchased extra supplies 217 times on 98 days. The diversions totaled 44.9

Table 18.--Extra receipts and diverted milk movements by day of the week by 14 selected plants in the Pittsburgh area during March, May, September, December 1963-expressed as percentages of 123-day average

Day	March		May		September		December		123-day total	
	Diverted to surplus	Extra receipts	Diverted to surplus	Extra receipts	Diverted to surplus	Extra receipts	Diverted to surplus	Extra receipts	Diverted to surplus	Extra receipts
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Sunday........	112.6	---	177.9	11.8	87.0	11.1	85.4	---	112.4	5.4
Monday........	80.9	25.8	180.4	83.5	58.5	43.2	72.8	66.2	94.5	54.6
Tuesday.......	92.0	119.8	146.9	256.6	55.3	82.9	71.8	107.5	90.4	139.8
Wednesday.....	118.4	22.0	182.1	137.4	71.0	168.0	68.7	152.6	114.3	121.0
Thursday......	68.7	36.2	158.0	171.8	23.4	136.9	45.4	165.9	78.8	130.2
Friday........	90.4	81.5	124.8	246.9	30.5	124.2	63.8	102.2	80.7	141.5
Saturday......	111.4	81.6	198.0	108.4	96.4	162.1	113.6	131.9	128.8	118.8
Daily average...	97.2	52.6	165.7	149.0	61.1	99.0	74.7	99.4	100.0	100.0

Table 19.--Number of days in which diversions or extra receipts of raw milk by 14 plants in the Pittsburgh area were within specified percentage ranges of the regularly scheduled producer receipts for those plants, 1963

Percentage of producer receipts	Number of days with diversions					Number of days with extra receipts				
	March	May	September	December	4 months (123 days)	March	May	September	December	4 months (123 days)
	Days	Days	Days	Days	Days	Days	Days	Days	Days	Days
0						12	3	5	5	25
0.1 - 2.5						4	4	2	2	12
2.6 - 5.0			4	1	5	11	4	9	7	31
5.1 - 7.5			1		1	3	8	4	5	20
7.6 - 10.0			3	1	4	1	5	9	10	25
10.1 - 12.5	2		4	2	8		7	1	2	10
12.6 - 15.0			8	3	11					
15.1 - 17.5	5			7	12					
17.6 - 20.0	8	2	2	5	17					
20.1 - 22.5	7	2	5	3	17					
22.6 - 25.0	2		1	4	7					
25.1 - 27.5	2	6	2	4	14					
27.6 - 30.0	3	2			5					
30.1 - 32.5	2	7			9					
32.6 - 35.0		3			3					
35.1 - and above		9		1	10					

Table 20.--Extra receipts, diverted milk, and offsetting movements by 14 selected plants in March, May, September, and December 1963

Item	Unit	March	May	September	December	4 months (123 days)
Total volume diverted	1,000 pounds	10,997	18,759	6,696	8,453	44,905
Diversions	Number	216	255	146	139	756
Days with diversions	Number	31	31	30	31	123
Volume of extra receipts	1,000 pounds	1,304	3,697	2,375	2,464	9,840
Extra receipts	Number	36	67	55	59	217
Days with extra receipts	Number	19	28	25	26	98
Days with offsets 1/	Number	19	28	25	26	98
Volume of offsets	1,000 pounds	1,304	3,697	2,076	2,371	9,448

1/ When diversions by a plant are offset by extra purchases in another plant.

million pounds, with 9.8 million pounds of extra receipts. Offsetting movements involved 9.4 million pounds on 98 different days. A movement was considered offsetting if any plant (A) diverted milk on the same day that any plant (B) brought in extra supplies. None were actually moved between plants (A) and (B). These offsetting movements offer potential savings in handling, transportation, and the level of reserve supply necessary to meet fluctuations.

With the exception of 6 days, more milk was diverted than was brought in as extra receipts. The net shortage on those days totaled 400,000 pounds.

Purchases of extra supplies and diversions both reached a peak in May. This is the expected pattern for diversions due to heavy seasonal milk production. The contraseasonal peak in extra supplies resulted from a competitive situation where two plants had unusually heavy fluid utilization. These extra supplies were obtained from sources other than the outlets for the diversions, even though large volumes of diverted producer milk were available and being utilized in lower-priced manufactured products. Plant managers are hesitant to take action that would give immediate competitors an advantage such as increasing their fluid utilization and blend price payable to farmers.

The irregularity of diversions and extra receipts, both in volume and timing, makes them more difficult to handle efficiently. Table 19 emphasizes these differences by comparing the diversions and extra receipts with regular producer receipts for the 14 plants.

HANDLING EXCESS SUPPLIES

Pittsburgh area handlers have developed a variety of ways to handle the excess milk not needed in their fluid, cottage cheese, and ice cream operations. The daily operations of 14 regular handlers during March, May, September, and December 1963 were such that each one had some excess milk. There were approximately 11 million pounds of excess milk in March, 18.8 in May, 6.7 in September, 8.5 in

December--a total of 45 million pounds in the 4 months. The milk was designated as excess only if the regular plant disposed of it for lower class use (butter, cheese, and similar products), by diverting or shipping to a manufacturing plant, or by processing in its own surplus facilities. These 14 handlers utilized 10 different surplus facilities to process the excess. Some of these facilities also processed supplies from other minor sources but receipts by each were sporadic in volume and in timing.

Receipts by plants producing manufactured milk products vary more than receipts by regular fluid milk handlers. Such a plant receives excess milk from several sources, serving as a sort of safety valve for handlers as they attempt to balance supply with utilization. The irregular pattern of receipts from each source is demonstrated in table 21.

Manufacturing plants face extreme seasonal volume differences (table 22). These manufacturing plants, whether separate firms or operated by a regular dealer, perform a service to the industry by serving as a ready market for excess supplies from fluid operations. They also provide a source of intermediate products, i.e., condensed milk, cream, powder, etc., for the dealers to use in making cottage cheese and ice cream. This is one of the functions of centralizing the handling of surplus milk, although erratic and not coordinated. Every dealer does not process all the milk his producers sell. However, without central coordination, much milk is moved to and from different areas of the market during the same day. This requires more facilities with a great deal more handling and transportation than necessary with adequate coordination. Much of this excess milk is handled in small lots.

This section compares the cost of manufacturing the excess milk from 14 regular plants under three alternatives: (1) each plant processing its own excess, (2) all excess manufactured in two coordinated plants, (3) the excess manufactured by three coordinated plants located in different parts of the market area. None of these is the actual practice--a combination of individual action by dealer and manufacturer with limited coordination.

Effective supply coordination offers a potential for improving efficiency comparable to that possible in processing. The ability to direct the milk flow in the market contributes to improved efficiency at all levels.

Table 23 gives the number of days during the 4-month period when the 14 fluid handlers had specified volumes of excess milk. It shows the excess volume at each individual plant and combines the volume of different groupings of plants for each day. The relative time that specified volumes of excess milk were disposed of by the individual plants and the different groupings emphasizes the greater regularity of supplies available for manufacturing at centralized plants. Individually, the 14 plants had no excess milk 56 percent of the time. They had some excess--less than 50,000 pounds--25 percent of the days. Over 50,000 pounds of excess milk was available about 1 day in 4.

Combining the volume of excess milk from the 14 plants so as to process it in 2 plants would permit more efficient operation of the facilities. There were only 2 days (less than 1 percent of the time) with no excess milk. Less than 50,000 pounds was available only 9 percent of the time. Adequate volumes must by available on a fairly regular basis for a plant to gain an acceptable level of operating efficiency and to maintain commerical sales outlets for the products.

Table 21.--Daily receipts from different milk plants for a 1-week period as a percentage of the total monthly receipts of a representative manufacturing plant

Day during second week in May 1963	Percentage of May receipts supplied by--											Total percentage of May receipts from all sources 1/
	Plant A	Plant B	Plant C	Plant D	Plant E	Plant F	Plant G	Plant H	Plant I	Plant J	Plant K	
						Percent						
Sunday	2.33	.26	.20									2.79
Monday	1.96	.22	.19		.08	.21			.28			2.93
Tuesday	2.23	.13					.11			.42		2.89
Wednesday	1.96	.23	.19			.18	.11	.20	.28	.42		3.56
Thursday	2.30	.26			.20					.81	.22	3.79
Friday	1.98	.40				.20			.28	.42		3.28
Saturday	2.34	.69	.19	.12	.11		.11	.15	.28	.39		4.39

1/ Rounded.

Table 22.--Number of days that total receipts by a selected manufactured milk products plant were a specified percentage of average during March, May, September, and December 1963

Range, percentage of average	Number of days in range				
	March	May	September	December	4 months
	Percent	Percent	Percent	Percent	Percent
0					
.1-49.9				1	1
50-54.9		1		1	2
55-59.9			7	2	9
60-64.9			4	2	6
65-69.9			2	4	6
70-74.9				2	2
75-79.9			9	3	12
80-84.9	1	1	4	2	8
85-89.9	6		1	1	8
90-94.9	2	2	1	1	6
95-99.9	4		1	4	9
100-104.9	4	1			5
105-109.9	3		1	3	7
110-114.9	4			2	6
115-119.9	3	2			5
120-124.9	1	3			4
125-129.9	2	2		1	5
130-134.9		2			2
135-139.9		4		1	5
140-144.9		2		1	3
145-149.9		2			2
150-154.9	1	2			3
155-159.9		2			2
160-164.9		1			1
165-169.9		1			1
170-174.9		1			1
175-179.9					
180-184.9		1			1
185-189.9					
190-194.9					
195-199.9		1			1

Comparative Costs of Handling Excess Milk

Based upon this daily flow, the costs of manufacturing excess milk into butter and nonfat dry milk were compared for the 14 individual plants and groupings of these plants. Although costs of processing other products would be somewhat different, the unit cost curves for different products do behave similarly. The actual cost levels would be different, but relationships would be comparable.

Model spray-drying plants synthesized by the Idaho Agricultural Experiment Station were utilized to compute the manufacturing cost. 2/ Model plants of six

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2/ Walker, Scott H., Preston, Homer J., and Nelson, Glen T. An Economic Analysis of Butter-Nonfat Dry Milk Plants. Idaho Agr. Expt. Sta. Res. Bul. No. 20. June 1953.

Table 23.--Number of days with specified volume of excess milk at 14 individual plants and groupings of plants in Pittsburgh area market during March, May, September, and December 1963

[Volume range 1,000 lb./day]

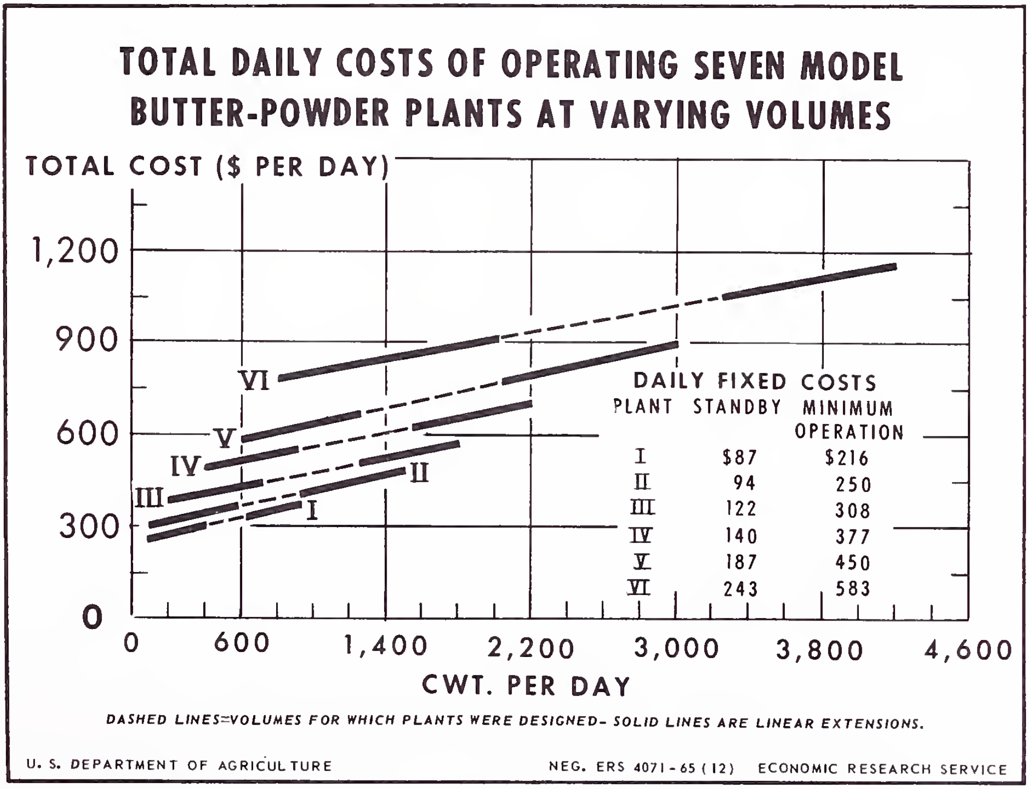
Plants and groups	Standby	1-24	25-49	50-74	75-99	100-124	125-149	150-199	200-249	250-299	300-349	350-399	400-499	500-599	600-699	700-999
	Days															
A	33	24	23	16	19	6	2									
B	80	3	39	1												
C	48	51	23	1												
D		3	2	8	10	15	32	40	13							
E	56	31	19	13	3	1										
F	104	6	5	2	1	2			1		2					
G	93	16	5	7	1	1										
H	89	13	21													
I	86	9	22	6												
J	69	49	5													
K	16	3	36	25	31	12										
L	83	1	3	8	11	6	6	4		1						
M	104	14	3	2												
N	105		13	3	2											
14 individual plants (1,722 days)	966	223	219	92	78	43	40	44	14	1	2					
Combined group W (ABEFHJ) (123 days)	8	17	11	19	20	11	16	10	7	1	1		2			
Combined group X (CGILMN) (123 days)	12	24	25	16	15	9	7	9	2	2	2					
Combined group Y (ABCDEFGHIJKLMN) (123 days)	2	9	12	8	10	14	13	15	13	11	6	4	2	3		1
Combined group Z (DK) (123 days)		1		5	2	9	11	36	30	24	5					
Total groups, W,X,Z (369 days)	20	42	36	40	37	29	34	55	39	27	8		2			
Total group Y,Z (246 days)	2	10	12	13	12	23	24	51	43	35	11	4	2	3		1
14 plants combined (123 days)			1	3	1	2	2	8	19	11	22	16	8	15	9	6

different capacities were considered. The smallest, plant I, was designed to operate at a minimum volume of 38,000 pounds of milk daily. Plant II was designed for a minimum of 55,000 pounds, plant III for 72,000 pounds, plant IV for 92,000 pounds, plant V for 125,000 pounds and plant VI for 197,000 pounds per day.

The upper volume of operation in a normal operating day was approximately 50 percent above the minimum operating level. Additional volume could be processed by working overtime or extra shifts.

The total daily costs for operating each model plant was computed by multiplying specified volumes by the average cost shown in the Idaho analysis. The total cost line for each plant was extended linearly above the normal rated capacity and downward to a minimum level in any given day. A fixed daily cost for each model plant was considered applicable to those days when no processing of excess milk was necessary. When exceptionally large volumes were available for a very few days, costs for the model plant were computed by operating for an additional day. This adjustment would have been practical with these flow patterns. Although these liberties with the synthesized data might result in slight fallacies in the actual cost, it was felt that the comparative relationships were adequately maintained. These relationships, rather than exact cost, are emphasized in this study.

Figure 8 shows fixed cost and the total cost per day for each of the model plants. Table 24 summarizes the total cost which could be expected when operating each plant at the actual volumes available. These costs are shown as expected if each handler were processing his own excess milk, and if the excess milk from the 14 were combined by groups of plants and processed in 2 or 3 surplus plants.


TOTAL DAILY COSTS OF OPERATING SEVEN MODEL BUTTER-POWDER PLANTS AT VARYING VOLUMES

DASHED LINES=VOLUMES FOR WHICH PLANTS WERE DESIGNED- SOLID LINES ARE LINEAR EXTENSIONS.

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 4071-65 (12) ECONOMIC RESEARCH SERVICE

Figure 8

Table 24.--Cost of processing excess milk for 14 Pittsburgh area plants during March, May, September, and December 1963 in individual plants and in plants that handle excess milk for groups of handlers [Volume range: 1,000 pounds of excess milk per day. Costs are operating costs: Number of days times daily cost of processing the given volume, including fixed and variable costs]

Plant and grouping	Model plant (of corresponding size)	Volume processed (1,000 pounds) Standby (0)	1 - 24	25 - 49	50 - 74	75 - 99	100-124	125-149	150-199	200-249	250-299	300-349	350-399	400-499	500-599	600-699	700-999	Sum of cost for 4 months
									Dollars									
A..........	II 1/	3,102	7,368	7,705	5,840	7,562	2,550	916										35,043
B..........	I	6,960	786	11,505	330													19,581
C..........	I	4,176	13,362	6,785	330													24,653
D..........	IV		*465	964	4,080	5,400	8,460	18,976	24,800	9,009								72,154
E..........	I	4,872	8,122	5,605	4,290	1,089	**553											24,531
F..........	I	9,048	1,572	1,475	660	363	**1,106			**865		**2,604						17,693
G..........	I	8,091	4,192	1,475	2,310	363	**553											16,984
H..........	I	7,743	3,406	6,195														17,344
I..........	I	7,482	2,358	6,490	1,980													18,310
J..........	I	6,003	12,838	1,475														20,316
K..........	II	1,504	921	12,060	9,125	12,338	5,100											41,048
L..........	III	10,126	*138	1,224	3,472	5,071	2,940	3,108	2,200		**914							29,193
M..........	I	9,048	3,668	885	660													14,261
N..........	I	9,135		3,835	990	726												14,686
Groupings:																		
Combined plants (ABEFHJ) W	V	1,496	3,485	2,629	11,172	12,400	7,172	10,976	7,180	5,600	860	**1,249		**2,826				67,045
As individuals																		134,508
Combined plants (CGILMN) X	V	2,244	*4,920	*5,975	9,408	9,300	5,868	4,802	6,462	1,600	1,720	**2,498						54,797
As individuals																		118,087
Combined plants (ABCEFGHIJLMN) Y	VI	486	*2,322	*3,432	*2,520	8,050	11,648	11,180	13,320	12,415	11,099	6,372	4,460	**3,334		**5,325	**2,604	98,567
As individuals																		252,595
Combined plants (DK) Z	VI		*258		*1,575	1,610	7,488	9,460	31,968	28,650	24,216	5,310						110,535
As individuals																		113,202
Groups W, X, Z,																		232,377
Groups Y, Z																		209,102
14 individual plants																		365,797

*Added only marginal cost - These volumes processed with other day's run include the standby cost for another idle day. **Cost of multiple of regular volume range less standby.

1/ See text for definition of model plants.

In each case, the appropriate size plant for the volumes available was the one selected as the model plant.

Managerial problems brought about by the violent fluctuations in volume are oversimplified by this method. Facilities and labor are not fully flexible. Some semblance of a regular crew must be maintained even though not fully utilized. These comparisons tend to understate individual plant operating costs, because the labor expenses were charged as though fully flexible. Some individual costs are overstated because those with small volumes of excess milk normally would not choose to process butter and powder.

Despite this relatively favorable treatment, the total cost for 14 individual plants would have been approximately $365,000 for the 4-month period (table 24). The total cost for manufacturing the combined volume in three plants would have been $232,000 and in two plants it would have been $209,000, a saving of 36 to 43 percent.

Considering the relative volumes involved, extending this difference to include all the plants serving the Pittsburgh area market would approximately double the potential saving. Receipts and utilization during the 4-month period were about one-third of the yearly total. On this basis, processing the yearly excess for the market in three centrally coordinated plants would have cost $798,000 less than if each major handler had operated individual facilities. Two plants would have cost $936,000 less to operate than the individual plants.

In addition to this saving in manufacturing cost, operations would be stabilized, because fluid handlers could utilize space, facilities, and labor more uniformly and efficiently than if each plant were processing all its producer receipts. Supply coordination fosters a greater degree of specialization by bottlers and manufacturers.

Flexibility and volume are vital to manufacturing plants. Because of the extremely variable volume of excess milk and the fluctuating demand for the various products there is a never-ending compromise between the need for flexibility and for volume of each product and in total.

CONCLUSIONS

Market organization may be both cause and effect of differences in functional efficiency. The level at which responsibility for supply-demand coordination is exercised influences efficiency in milk marketing. The pressures generated by these differences in efficiency in turn influence organizational responses.

Much of the potential gain from supply coordination is external to the firm. Realization of these gains depends upon actions taken by the market rather than by a specific firm. Central supply-demand coordination and the subsequent efficiencies in milk marketing can be attained within the present legal and regulatory framework with minimum disruption.

Effective competition does not depend upon each handler bearing responsibility for every functional activity from procurement and collection through processing and distribution. Some of these functions can be performed more effectively by one participant than by another. Specialization, economies of scale, and less uncertainty lead to greater efficiency. Some handlers could compete more vigorously if they were not hampered by the restrictions inherent in individual procurement, collection, assembly, and in handling the surplus milk. If handlers can isolate their processing and distributing activities from these inadequacies, they can adjust operations to meet market needs.

Price determination, whether by bargaining or by administrative action, needs to reflect the value and cost of these functions by compensating the firms responsible for executing them.

Central coordination reduces fixed costs, uncertainty, and variability, while providing flexibility and an effective vehicle for adjusting volume, product mix, and rate of flow to achieve timeliness. Mutually beneficial functions often may be effected more readily through this type of market organization than by individual handlers acting separately.

Especially significant savings may be realized in handling and processing excess milk. These excess supplies are sporadic in timing and volume; combining them alleviates the fluctuations. In addition to the economy, combining these excess supplies permits greater stability in providing intermediate products for the trade.

Milk marketing firms would do well to examine the traditional goal of providing 100 percent satisfaction of effective demand from regular producer supplies. Comparing shortages and surpluses under 100, 99, 95, and 90 percent satisfaction suggests that a lower "satisfaction ratio" may be beneficial to the market. The cost of producing, handling, processing, and marketing the varying amounts of surplus for different levels of satisfaction from regular sources should be compared with the costs and feasibility of securing supplementary supplies. Generally, the volume of supplementary supplies needed would be much smaller than the volume of surplus generated by carrying reserves large enough to meet all needs. Shortage periods are usually brief, while reserves for those periods become surplus throughout the rest of the year.

Much of the operating variability and uncertainty is concealed in monthly accounting periods. Plant managers consider the week as an operating period and strive for a weekly supply-demand balance. The degree of this concealment depends upon the degree of fluctuations and the competitive situation.

The relative fluctuations between producer receipts and fluid utilization are different when measured by weeks rather than months. For 7 plants individually, weekly variations in fluid utilization were responsible for 52 percent of the 16-week surplus, with 48 percent arising from fluctuating producer receipts. When the 7 plant volumes were combined, only 26 percent of the weekly surplus came from varying fluid utilization, with 74 percent from varying producer receipts. Monthly individual plant variations in producer receipts accounted for 64 percent of the surplus, with fluid use fluctuations responsible for 36 percent. For the 7 combined volumes, variations in monthly producer receipts contributed 79 percent of the surplus and fluid utilization only 21 percent.

A 7-percent monthly reserve supply would have been needed by the individual plants during the month of relatively short supply to meet all their fluid needs within each week. A 3-percent monthly reserve would have met all weekly fluid demand for the combined group.

The most satisfactory ratio of producer receipts to fluid utilization depends upon the interrelationships of the several variables in any given market situation. A lower reserve ratio would have provided any specified level of satisfaction from regular sources for the combined group than would be needed by the plants acting as individual supply-demand coordinators. The potential benefits from central supply coordination vary directly with the degree of fluctuations.

Surplus from variation in weekly producer receipts was 21 percent lower when the 7 plant volumes were combined than when they were considered separately. The surplus from fluid variation for the combined plants was only 25 percent of that from individual variation. Considering both sources, the surplus from variation for the 7 plants combined was one-half that for the same plants individually.

In addition to random and basic differences in supply and demand patterns between the plants, part of the variations were competitive. Consumers switched their patronage from one plant to another to a greater extent than they altered their aggregate milk consumption. This type of switching was not so disrupting on the supply side.

Decreased variability and uncertainty, together with economies of scale, are the primary sources of potential gains from altering the form of supply coordination. The Pittsburgh market could realize these benefits from supply coordination including:

1. Lower reserve requirement.
2. More effective handling of surplus milk.
3. Facilitating out-of-market shipments and inshipments.
4. Lower procurement and quality control costs.
5. Lower collection, receiving, and transportation costs.
6. Greater time, product, and outlet flexibility at lower cost.
7. Improved communication and bargaining between participants.
8. More effective competition at certain levels.

Only the first two sources of efficiency have been considered explicitly in this analysis. In addition, alleviation of the volume and timing problems permits building space to be utilized for other needs. Labor coordination may be more readily accomplished and less time lost in transition. Adjustments in volume may be made almost instantly. The plant can exercise real control over its receipts of raw milk, rather than being a victim of fluctuations in production. Sales competition need not be limited by the effectiveness of the competition on the procurement side.

These advantages are not realized automatically by simply shifting to a full supply arrangement. Management must adapt plant operations to secure the potential benefits. There are changes in bargaining power and relationships as responsibility for certain functions is shifted. In addition, some offsetting disadvantages may be experienced by individual handlers in turning to full supply and central supply coordination. A firm with a very efficient procurement and assembly operation loses this competitive advantage without gaining a comparable advantage over competitors. The same may be true for those with outstanding quality programs. Some advertising benefit may be lost by firms that now employ a fleet of attractive trucks with plant identification to collect the milk. Certain plants have been in a position to realize profits from timely spot sales on attractive terms or from processing the surplus into manufactured products.

Individual handlers become more dependent upon the organization responsible for supply coordination. This dependency increases their vulnerability to possible improprieties in supply, collection, and quality programs, and to activities such as milk strikes and labor strikes. This is especially true when centralized supply coordination is associated with hired drivers, rather than individual contract haulers.

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Central supply coordination reduces the direct personal relationship between farmer and processor and may reduce the processor's ability to secure a desired response from individual farmers. The processor could be seriously handicapped if incompetent or biased management developed in the coordinating agency.

Individual firms also may lose the opportunity to gain a competitive advantage from innovations in procurement, collection, assembly, receiving, or in producer relationships. The possibility of one handler exploiting the competitive weakness of another in these areas is reduced.

Although some of these relinquishments may not be considered as losses by the industry or by society as a whole, they may represent a sacrifice to an individual handler in his relative competitive standing.

Market organization evolves through the continuing responses and efforts of all participants seeking the most satisfactory competitive relationships. These responses are of two types: Those where individual units seek to adapt their operations to better fit the competitive environment and those where the cumulative efforts are designed to adapt the environment to provide a more favorable milieu.